JOURNAL OF MAMMALOGY

Vol. 16 MAY, 1935 No. 2

AMERICAN SOCIETY OF MAMMALOGISTS

The American Society of Mammalogists

Founded April 3, 1919
Incorporated April 29, 1920

The Journal of Mammalogy

Subscription rates, $4.00 per year; single numbers $1.00 each. Sent free to all members of the American Society of Mammalogists not in arrears for dues.

Subscriptions, changes of addresses, requests for missing numbers, applications for advertising rates, etc., should be sent to the corresponding secretary, Robert T. Hatt, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y.

Manuscripts for publication, books and papers for notice and reviews, etc., should be sent to Edward A. Preble, U. S. Biological Survey, Washington, D. C.

Entered as second-class matter, November 22, 1919, at the Postoffice, Baltimore, Md., under the act of March 3, 1879.

Made in United States of America

JOURNAL OF MAMMALOGY

Published Quarterly by the American Society of Mammalogists

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ON THE HABITS OF SOME MADAGASCAR MAMMALS

BY A. L. RAND

The following notes were made during the period 1929–1931, while I was collecting birds and mammals as member of the Mission Zoologique Franco-Anglo-Américaine à Madagascar. General accounts of the work of this expedition have been published by Jean Delacour (1930) and myself (1932).

A partial list of the mammals secured has been published by Delacour (1932), but the collection as a whole has not been critically studied. The present paper consists of field observations, made by myself unless otherwise stated.

INSECTIVORA

Tenrec ecaudatus Linnaeus. The tenrec was common in most parts of Madagascar from sea level up to about 1000 meters, except in the arid southwest, where few were seen. It appeared to prefer the brushlands and clearings of the dryer forests of the west, and to avoid the rain forest of the east.

It is apparently largely nocturnal, but on March 6, 1931, near Namoroka, I encountered a female and a number of young moving about in the forest during the morning. Usually its days are spent in burrows in the ground, for I frequently saw tracks leading into such situations; on November 27, 1930, at Bezona, I found five in a hollow log lying on the ground in light forest.

At various times I had numbers of these animals alive. They were usually silent; occasionally one carried by a native, with a cord tied around its lower jaw, squeaked or squealed; sometimes one gave a low hissing note when annoyed, and those aroused from hibernation made a puffing or grunting noise when disturbed.

During the dry season or austral winter, that is, from May to October, or possibly for only part of this period, these creatures hibernate. Specimens from Vondrozo in July, from Ivohibe in August and September, and from Mt. d'Ambre in October, were in a torpid state, while active individuals were found at Tabiky, October 29, 1929, in the Sambirano in November, and south-east of Soalala in March.

During August, at Ivohibe, many were brought to me by the natives, who said they had dug them out of their burrows. Some of these were still torpid, others had been somewhat aroused by the rough handling they had received. When placed on the ground they usually stood still in a rather dazed manner, paying little attention to what was happening unless they were touched. They usually made no effort to escape and

if they moved about were unsteady on their feet, sometimes falling over as they tried to walk.

The surest way to arouse one was to seize it by the bristles of its back, when it would puff or grunt and snap and sometimes erect the long crest of spiny bristles on the back of its head, and toss its head. The bristles are not stiff enough to pierce the skin of the hand but it is interesting to compare this action with a similar one of *Hemicentetes*, whose stronger spines make the move more effective. Several tenrecs, confined in the same box with some *Hemicentetes*, snapped at the latter as they passed until their mouths were full of spines. When a tenrec roused from hibernation was left to itself it usually resumed a torpid condition, curled up, lying on its side, eyes closed, with its breathing scarcely perceptible, and with the body cold to the touch.

By offering a reward, I was able to locate three burrows in which tenrecs were hibernating. I dug out two of these after watching the natives dig out the first. The one, August 18, 1929, at Ivohibe, was in open rolling to hilly country, largely covered with herbs and grass, with here and there clumps of brush. In a clump of scattered brush in a hollow on the hillside, the native showed me where he had dug out an old tunnel, just below the surface, for some 1500 mm., to where the animal had started to descend into the ground. At first I could see nothing, but the native digging with a pointed stick showed me that the tunnel was plugged. The packed earth that filled it was different enough from the surrounding soil to be discernible after close scrutiny. The native dug down some 600 mm. until he broke through into the chamber containing the animal. It had been aroused by the digging and was facing us, puffing occasionally, but making no effort to move. The native dug out around it and I brushed some earth from its face, but it showed no resentment, except as it gave an occasional toss of its head when touched, and made a puffing sound.

This burrow had started by a small root of a tree and had been dug just below the surface for nearly 1500 mm. through the dark humus. This part had not been plugged. It then made a turn of about eighty degrees and began to descend. This part had all been plugged. It led to the chamber, about 700 mm. farther on, and some 300 mm. below the surface. This chamber was situated just above the red clay that underlaid the dark surface soil. The chamber was approximately 130 mm. wide, 80 mm. in length, and 70 mm. high. The walls were smooth and solid but were not hard packed. The chamber was perfectly clean. No feces or hair could be found.

When the occupant, a female, was removed from the earth it behaved as the other captives had done. As long as it was undisturbed it stood stupidly. When picked up by the hair of its back it snapped and puffed or grunted and when put on the ground again stood high on its legs, balancing with difficulty and paying no attention to anything about it. The boy carried it back to camp in his hands, not by one foot as the natives often do, and when we reached camp it had resumed its torpid condition, and was curled up with its nose between all four paws and its eyes closed. I put it on a table and after a time it roused itself and stood up but soon became torpid again. When torpid, its rate of respiration was about thirty per minute but its breathing was very slight. It was cold to the touch.

On August 20, 1929, at Ivohibe, natives brought in word that they had found two hibernating tenrecs. They guided me out into the open, hilly, grassy country with occasional areas of brush and low trees. The first tunnel was on a rather bare hillside with a southerly slope.

The burrow started under the base of a bush and ran along just under the surface for 100 mm. It had not been plugged. Then it turned sharply and entered the hillside leading to the chamber perhaps 275 mm. farther on. This part of the burrow was all plugged with soil; the difference in the packed soil of the tunnel was quite evident to the natives, and after a while to me. This soil had been packed in solidly from within

and was stratified, so that it fell away in curved flakes as the soil was removed from around it.

The surface soil was very scanty here, and the tunnel led directly into the hard red clay, going down at a slight angle. The hardness of the soil probably accounted for the shallowness of this burrow. When I opened the chamber, the animal, a female, was standing on its feet, its side to the entrance, but with its head slightly turned toward it. It was in a torpid condition, cold to the touch, its breathing not perceptible. When removed and handled gently, it partly opened its eyes, moved about a little, and when placed in a box to be carried back to camp, became torpid again. Later, at camp, it became somewhat active.

The chamber was 130 mm. long by 180 mm. wide and 115 mm. high. It was oval in shape with the floor somewhat flattened. The walls were firm and smooth but not hard-packed. The chamber was perfectly clean, no hair or feces about, but it contained a number of smooth, rounded balls of clay, 10–30 mm. in diameter, with a stone in the center as a nucleus, apparently formed by having been continually rolled about. They were on the floor of the tunnel, one under the abdomen and another under the left hind foot of the creature. The natives said that the animals lick them during their long sleep, as they have nothing else to eat.

The third burrow was 300 to 400 meters away on a steep northern slope on the other side of the hill, amongst a group of brush and low trees. What appeared to be an old tunnel ran along in a horizontal plane, just below the surface of the soil and the natives had opened this to the place where the plugged burrow led directly into the hill, going down at a slight angle. The dark surface of the soil was some 300 mm. deep here, and where the burrow had been plugged with red sand from the sub-soil it stood out very plainly as a round red plug about 80 mm. in diameter. The tunnel led down, nearly straight, to the chamber, a meter farther on in the sand and 1100 mm. below the surface. The chamber was perfectly clean and contained one packed lump of sand, about 10 mm. in diameter, probably comparable to the lumps of clay found in the other burrows. This burrow, which was the deepest of the three, was in very soft soil.

This tenrec, a female, had not been disturbed by the digging and was lying on its side, curled up, with its back to the entrance. Its eyes were closed, breathing was not perceptible, and it was cold to the touch. On being gently handled, it behaved much as had the others. When placed on its feet at camp, it stood stupidly all afternoon, not walking about at all.

Apparently the sleep is uninterrupted; all the animals examined in this condition from July to October were excessively fat and there was no trace of food in the body or of feces in the burrows. Round worms were very common in the alimentary tracts of these animals. None of the many females removed from hibernation contained embryos. A female at Tabiky, October 29, 1929, probably not long out of hibernation, contained 25 embryos. At Benzona, November 27, 1930, I removed four females and one male from a hollow log in the forest. Three of these females had 18 very small embryos each. Probably they mate shortly after they come out of hibernation, and the period of gestation is probably short. Young, one-third grown, were found March 6, 1931, near Namoroka; and young were found in May, 1930, at Maroantsetra.

The young probably lose their streaked juvenile pelage before they go into hibernation as none of the numerous hibernating examples from Ivohibe were in this pelage. The young probably keep together and follow the adult until they are at least one-third grown. Near Namoroka, March 6, 1931, a female and a number of young, one-third grown, were found moving about together in the light forest, and at Maroantsetra (40 km. north) the natives brought in a number of young that were said to have been taken from one burrow.

The five tenrecs from Bezone, November 27, 1930, taken from a hollow log after the

hibernation period, had finely ground up animal matter in their stomachs, including caterpillar and beetle remains. One from Tabiky, October 29, 1929, had finely ground insect matter in its stomach. A native pointed out to me on March 6, 1931, near Namoroka, the place where one had been searching for food. The surface of the ground had been disturbed and little funnel shaped holes, 25 to 50 millimeters deep, had been made in the black soil. These little funnel shaped depressions were probably made by the animal rooting with its tough, bare nose, which is somewhat flexible.

The animals had a characteristic sharp odor, particularly noticeable when several were confined in a box or when one was cut open. Despite this they are prized by the natives for food, because of the large amount of fat on them, though I did not like the flavor. The native method of preparation was to singe the body, scrape off the bristles and epidermis, disembowel it and then cut it in pieces and boil it. The native name was "tandraka."

Hemicentetes semispinosus Cuvier. This species apparently frequents the brushlands and the edge of the forest. At Ivohibe, in August and September, 1929, many were brought to me by natives who said they found them in shallow burrows. At one time I had more than forty captives which the natives had brought in alive.

Hemicentetes is an active little creature, moving about in the box in which it was confined both during the day and night. At Bevato, my companion, Philip A. DuMont shot one moving about in the brush during the morning.

When this animal is walking, its hind feet stand out at right angles to the body. The little area of heavy spines on the middle of the back often vibrates rapidly, independent of the rest of the back. When disturbed or touched it spreads the "crest" of spines on its head, puts its head forward close to the ground, and the quick upward movement of its head and body that followed was evidently a defense movement. When the creature was carefully handled, the spines did not stick into the hands, but they would do so under rough handling. A tenrec in the same box with several *Hemicentetes* bit at them until its mouth was filled with spines. When *Hemicentetes* were handled they did not attempt to bite but sometimes uttered a faint chattering or squeaking noise.

They are apparently active throughout the year, though possibly less so from May to October. At Ivohibe in August and September the specimens that we examined were very sluggish and cold to the touch after a cold night, but usually had some finely ground material in the intestinal tract, showing that they had not long been inactive. The natives said that they sometimes remained inactive for a day or so at a time and on August 16, 1929, at Ivohibe, I was shown one that had been dug out, though the burrow had been covered again and the animal left in it until I should arrive. It was in the rich dark soil by the river, which was being prepared for planting manioc. The burrow had been destroyed but the animal was in a cavity about its own size, some 150 mm. below the surface. The walls of the cavity were somewhat firm and smooth, but not as if it had been used for a long time.

This animal was not very active and showed the usual characteristic attitude when disturbed, spreading its crest forward and jerking the head. It made no effort to escape. I saw many places along the trail through the brush and grassland along the river where the natives had been searching for them. The places all seemed alike, short shallow tunnels, from 240 to 500 mm. long, and only a few centimeters below the surface.

Hemicentetes was called "sora" in the southeast amongst the Bara and Atamoor and in the northeast amongst the Betsimisaraka. At Tabiky among the Masquer this name was used for the hedgehog (*Setifer*).

Setifer setosus Schreber. The Madagascar hedgehog apparently inhabits the brushlands of the east and the dry forests of the west of the island. It is nocturnal, several being seen at night, and three kept alive for a time were active only at night. One was seen at Tulear where it took shelter under a building. At Monjakatompo, on May 22,

1929, the natives brought in three alive; these were placed in a box with sides about 300 mm. high. The hedgehogs made no effort to escape over the sides or to dig out. They had rather an offensive odor when confined. During the day they remained in one corner of the box, curled up so that only the tip of the nose was visible, and every now and then one would uncurl and attempt to get underneath the one on the bottom. As night fell they became active and walked about in the box, their hind feet standing out at nearly right angles from the body.

When disturbed they uttered a low, rather explosive "pouf-pouf," and occasionally a sharp squeak. When touched they either curled up or gave a jump that would scratch an incautious finger on their matted spines. They did not drink from a pan of water I put in for them, but one of them, that walked through the pan, sat down and began licking its paws and abdomen which had become wet. One night when I put the skinned body of a bird in the box, they began to eat it at once, chewing off the flesh from the breast.

They apparently do not hibernate, for at Ivohibe in August, when the tenrec was hibernating, many active hedgehogs were brought to me.

The hedgehog was called "sokina" in the southeast amongst the Bara and the Atamoor, and in the northeast amongst the Betsimisaraka; at Tabiky amongst the Masquer it was "sora" (a name used for *Hemicentetes* in the southeast), and "tambotika" amongst the Sakalava at Namoroka.

CARNIVORA

Viverricula malaccensis Linnaeus. This civet did not appear to frequent the dense forest but preferred the secondary brush in the vicinity of the villages in the east and northwest. It was often brought in by the natives. On November 8, 1930, fifteen miles southwest of Tsarakibany, a female was taken that contained four very large foetuses. DuMont found this animal moving about in the brush near the village during the middle of the morning. At Namoroka on March 7, 1931, two small young were brought in that were said to have been taken from a cave in the limestone. Of three stomachs examined all contained locusts or other insects; one also contained feathers, possibly of a chicken; and one, a mammal (*Rattus*?) and a snake.

This spotted civet was known as "halasa" by the Atamoor and Bara in the southeast, and "zaboady" by the Betsimisaraka in the northeast.

Fossa daubentonii Gray. The striped civet of the humid forest is apparently entirely nocturnal; one was seen in the light thrown by the headlights of the car 20 kilometers west of Vondrozo about 9 p.m., but though fairly common there, as we found by trapping, none was seen in the daytime.

Three stomachs from near Vondrozo and one from near Maroantsetra all contained insect matter and one contained also a lizard about 100 mm. long. One specimen from near Vondrozo, June 26, 1929, had gnawed off its toes below the jaws of the trap and had swallowed them. The striped civet was known as "fanaloka" amongst the Atamoor in the southeast.

Cryptoprocta ferox Bennett. The fossa inhabits the rain forest of the east and the dryer forest of the west at least as far south as Tabiky, and was well known to the natives. I saw one in the clearing in the forest near Tsarakibany, about ten o'clock on a bright morning. DuMont saw one in the forest east of Maromandia one morning. The natives, however, said it was nocturnal, and once on Mt. d'Ambre, while hunting lemurs about three o'clock in the morning, I heard the drawn-out whistle that the natives said was the fossa's characteristic call. When angry it was said to curve its tail over its back.

This viverrid was much disliked by the natives because of its raids on their fowls. Twice I saw fossa skins in the possession of natives, but this was probably due to Euro-

pean influence as the natives rarely use mammal skins for any purpose. One large fossa was brought to me that had been run down with dogs and speared. From the natives we heard no accounts of its attacking sheep or young cattle and its reputation in literature for ferocity and the fear with which it is regarded by the natives is exaggeration. My gun boy had a particular antipathy for it because, he said, in his country near Vondrozo, where the dead are walled up in caves, the fossa sometimes dug out the corpses and fed on them. The natives universally called it "fossa."

Galidia elegans Geoff. St. Hilaire. The galidia, an active, graceful creature, was often seen during the daytime, darting across the trail like a squirrel or bounding about on the forest floor. It also climbed well and was occasionally seen on the trunks of trees or in the lianas. When surprised in a tree it usually scrambled to earth and hurried away amongst the ground cover; but one, five meters up on the slanting trunk of a low tree in the forest, crouched there quietly, head downward, and would have escaped observation but for a little flycatcher (*Newtonia brunneicauda*) which scolded it, and so attracted my attention. It clung there watching me; I fired and missed and then it leaped into the air, fell to the ground like a squirrel and made off through the underbrush, uttering a plaintive whining note. A live specimen that was brought in by the natives had a basket, at least equal to its weight, tied to its middle and dragging this it climbed up one of the smooth corner posts of the veranda of the house where we were staying. It is usually solitary, but occasionally a pair was seen running about together on the forest floor. At Vondrozo a female was removed from a trap at nine-thirty a.m., and when the trap was revisited an hour and a half later, it held a male. This animal responded readily to squeaking and once when I was sitting quietly in the forest squeaking for birds, a galidia came up to within a few feet of me before it noticed my presence.

The following are the contents of four stomachs:

No. 1—June 22, 1929, Vondrozo; locusts and a few feathers.

No. 2—July 9, 1930, near Maroantsetra; orthopterous insects and reptile remains.

No. 3—July 9, 1930, near Maroantsetra; lizard remains.

No. 4—July 14, 1930, near Maroantsetra; orthopterous insects and beetle remains.

The native name is "vontsira."

Galidictus striata I. Geoffroy. A specimen from Lac Tsimanampetsotsa, February 15, 1929, was taken in the dry forest on the eastern side of the lake. Shortly after dark it was heard rattling the stones of the sterile soil as it dug up the bodies of skinned birds buried near camp. I approached cautiously and seeing its yellowish eyes shining in the rays of the torch, I was able to shoot it. Tracks, probably of this species, were frequently observed in the dust of the trails through the forest.

ARTIODACTYLA

Potamochoerus larvatus Cuvier. These hogs were not uncommon in and about the forest, except in the arid southwest. They were seldom seen but their signs, trails, rooting, and depredations on gardens indicated their presence. The natives hunt them with dogs, which bring the hogs to bay. Usually they spear them as few natives have guns. At a little newly established village, west of Andapa, where pigs were common, the natives had killed at least 43 during the three years the village had been there, as we found by counting the jaw bones, saved as trophies of the chase and exhibited on a pole in front of the village.

Large cage traps of poles, bound together with vines and with a sliding door, are often set for these animals, especially near cultivated land. These traps are usually baited with manioc, but one at Ivohibe had in addition a pole driven into the earth in front of the trap with the upper part smoothed and painted with black and red rings. Hung up some ten meters away on each side of the trap was a pair of wooden billets, 100 x 150 mm. long, with red and black bars painted across them. The native pointed to them

with evident pride, saying they were the most important element in his success. In any event he took two large pigs in that trap during the month or so I was in the vicinity.

One female taken at Iampasika, one day north of Ivohibe, on August 22, 1929, contained three embryos, two in the right horn of the uterus and one in the left. These measured (crown to rump) 80 millimeters.

The wild hog is called "lambo," almost universally, while domestic pigs are called "lakeshou."

LEMUROIDEA

Microcebus murinus murinus Miller. At Tabiky, the mouse lemur was apparently very common and numbers were brought in alive by natives, who said that they had taken them from holes in trees. On November 2, 1929, fifteen specimens were brought to me. The females taken in October and November were all pregnant, usually containing two embryos, sometimes three.

A male and a female goshawk (*Astur henstii*) that I shot near their nest near Tabiky in November, 1929, each had part of a *Microcebus*, possibly of the same individual in its gullet.

Cheirogaleus medius E. Geoffroy. These little lemurs are apparently entirely nocturnal and the natives said that they pass the day in holes in trees. Live specimens brought in by natives showed an antipathy towards bright light. At Tabiky, I found them in a gallery forest through savanna and dry brush. One that I saw plainly one night by the rays of an electric torch was in the lower limbs of the trees and branches of saplings, no more than three to five meters above the ground, running about like a squirrel rather than like its relatives of the genus *Lemur*.

Phaner furcifer Blainville. Near Tabiky, in November, 1929, I found the squirrel lemur fairly common about my camp in a gallery forest through savanna and low dry brush. The animals were noisy and entirely nocturnal. I was usually apprised of their presence by their chattering call, heard as soon as darkness fell and throughout the night. Usually found in pairs, though the females contained no embryos, they sometimes moved about rapidly through the tops of the tall trees, but more often were in the lower trees and bushes, sometimes within five meters of the ground, and were then comparatively easy to find, their eyes gleaming orange in the rays of the torch as they stared at it.

In the rain forest on Mt. d'Ambre this lemur was fairly common, and noisy throughout the night, but it kept to the tops of the forest trees, where it moved about rapidly.

Hapalemur griseus olivaceus I. Geoffroy. The hapalemur is diurnal; in the rain forest it was found moving about in the tops of the lower forest trees. On the edge of the forest it was occasionally seen in the dense thickets of bamboo. Occasionally found singly, it was more often seen in groups of two or three. At Manombe in the southeast I saw two running about through the forest tree tops; one of them stopped for a few moments; twitching its tail nervously this way and that and, raising its head gave a squalling cry.

Hapalemur was fairly common about camp two days northeast of Maroantsetra. When alarmed the two or three individuals usually found together would flee through the branches in mad haste, seldom stopping until out of sight. This animal is well known to the natives as "bokinbola."

Lemur catta Linnaeus. The ring-tailed lemur was found in and about most of the more densely-wooded areas and the gallery forest in the arid parts of southwestern Madagascar.

It is a diurnal and crepuscular creature, usually seen moving about and feeding during the day, but it was occasionally heard calling during the early hours of the evening.

The members of one such party were calling from the trees near the camp at Tsimanampetsotsa; their eyes shone yellow in the torchlight.

This animal, like most of the lemurs, is gregarious. It was usually seen in parties of from four or five up to ten or fifteen and more. These bands consisted of males and females. Females carrying young or accompanied by partly grown young were found in some bands. The animals spend as much time on the ground as in the trees. In the trees they move about much like the other members of the genus *Lemur*, walking along the horizontal limbs and jumping from branch to branch but they are not as agile or as active as the others of this group. On the ground they are quite at home, moving about on the flat ground or amongst the broken rocks and up into the bushes. Often when a party of them was alarmed they did not attempt to escape into the trees but went bounding away over the ground. These lemurs are not always shy. Near Ampotaka, where they are accustomed to the natives, I watched parties of them for some time as they walked unconcernedly about on the branches overhead and occasionally looked down at me. At Lake Tsimanampetsotsa, where they probably did not often see natives, they exhibited a certain amount of curiosity. I came upon one party on the ground, and as I stood still, several of them came within a few yards of me, barking nervously and attempting to get a better view. Near Tulear they sometimes remained close by the road while a car passed.

At Ampotake I surprised a party of these animals in an isolated clump of low trees in a corn field. They at once came to the ground and went bounding away over the field. I sat down and waited. In a few minutes they came back, this time from a different direction, and started to feed on the leaves of the trees.

Their usual call, as given by an undisturbed party, is a barking "wac-wac-wac," several members of the band calling at the same time. This I have heard both during the day and the night. When they are slightly alarmed or excited over an intruder, they give low grunts or barks. Captive specimens often purred contentedly, much like a cat.

Wild specimens were seen to eat leaves of certain trees, while captive specimens ate cooked rice and bananas, and one young captive was very fond of sugar and candy though it did not like chocolate. At Tsimanampetsotsa, I startled a party of these lemurs in mid-morning from the edge of a spring where they were apparently drinking. Captive specimens drank water readily, and one little fellow even drank hot chocolate, and whisky and water.

The ringed tail is a striking thing and an animal would often have escaped observation but for this. I surprised a party of these lemurs at close range one morning at Tsimanampetsotsa, and one attempted to escape observation by "freezing" rather than by flight. It was on a dead gray tree that matched its color very well and I would have failed to see it if the ringed tail had not attracted my attention. Though within a few yards of me it remained without a movement, not even turning its head my way until, sure that it had been observed, it abandoned its pose and sought flight.

The small young are carried by the mothers, as I found by shooting several females, though unaware at the time that they were carrying young. Only one young one was found with a female. Unfortunately I did not see how they were carried, though probably they were carried much as are the young of *Lemur fulvus*. The young are apparently no longer carried when about half grown as I saw a number of half-grown young in various parties that were making their own way; *Propithecus* of the same size would probably have been carried.

Captive specimens usually assumed a grotesque attitude while sunning themselves. They sat up on their haunches with the body upright and with the fore-legs raised and spread out so that the scantily haired abdomen was exposed to the sun's rays. The hind limbs were sometimes extended as well. One captive specimen used to sleep some-

times with its nose tucked down between its hind paws and its tail curled up over its back. Another showed no fear of a large dead snake but the shadow of a passing crow or kite made it crouch and seek shelter.

These creatures are hardy, stand captivity well, and show considerable affection, expressed by purring notes. They are often kept as pets by Europeans and are carried to various parts of the island. Many of the natives had small live lemurs of this species and they were frequently taken aboard the boats at Tulear to be sold to the crews.

This lemur was called "hira," though many natives use the French term "mac."

Lemur fulvus collaris E. Geoffroy.[1] At Vondrozo, in June and July, this lemur was common in the rain forest, usually traveling in the trees in parties of from four to six. Diurnal and crepuscular in habits, it makes a grunting noise when disturbed and has a call that may be written "qua-qua-qua-creee"—the first part low and throaty; the last loud and squalling. This call was usually heard in the evening and early morning, and occasionally during the day. On July 19 I saw a female crouched on a limb, apparently enjoying the sunshine. Certain fruit trees are favorite feeding places, visited regularly in the early evening.

The animals were not shy and could be closely approached as they sat staring down at the intruder, peering this way and that, switching their long tails that hung straight down, and grunting or walking about on the limbs. Slightly alarmed, they crouched motionless on the branches; frightened, they broke into flight, running along the limbs and jumping from one to another. This manner of travel is quite different from that of *Indri* and *Propithecus*.

Several stomachs examined contained woody fruits of forest trees and one, green vegetable matter that was possibly leaves.

At Manomba in October many females were carrying young, a single one in each case. The small young cling to the underside of the mother's body, across the loins, with the head up one side, the tail up the other. The hind feet are reversed so that they grasp in opposition to the pull of the front feet.

On October 1, 1929, I shot a female with young from a party and the rest fled except one female, that probably was attracted by the whimpering of the fallen young. She came within a few yards of me, circling about grunting, clinging to the vertical trunks of saplings and springing from one to another like a *Propithecus*, the horizontal branches adapted for the usual mode of progress being lacking. A few days later I saw a party of these lemurs traveling through the forest in their usual manner, walking along the branches and jumping from limb to limb. Then came an area of low saplings; they descended into them, and here again hopped from upright to upright, like *Propithecus*, until past the saplings. They sometimes descend to the ground, as J. C. Greenway, one of our party, saw a band of several cross a road through the forest on foot, but they dislike to descend to the ground, a fact that is taken advantage of by the natives in snaring them.

One trap I examined was a line of poles set up on forked sticks across a long, narrow clearing, forming a bridge from the trees on one side of the clearing to those on the other. Along this bridge several snares were set, held upright by loops of slender sprouts lashed to the poles. Later I found this method in use in other parts of the island for other races of this lemur and for other species. Sometimes a spring pole was attached to the snare and sometimes the snares were baited by putting bananas or guavas on a platform in the middle of the bridge.

"Varika" was the local name for this form.

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[1] The subspecific groupings of the animals from the central and southern part of the rain forests of the east are still not clear. The animals from Manomba may prove to be different from the Vondrozo specimens.

Lemur fulvus albifrons E. Geoffroy. The effects of hunting by natives on the animal life of Madagascar are negligible. The main destruction of the fauna is caused by the cutting of the forests. But near Maroantsetra we saw what might happen. Near the town itself these lemurs were scarce and very wary, apparently having been hunted with guns, but once away from large settlements they were very common and tame. On July 22, 1930, two days northwest of Maroantsetra, I surprised a party of eight in the low bushes of the ground cover in the forest. They fled but a little way and I sat down to watch them. Very soon the whole party came back and resumed feeding on the fruit of a low bush near me.

Parties of these lemurs were often heard grunting and growling in the forest as though fighting, and one male I collected here had large bare scars on its body as though from fights. The old males had a very strong, rank body odor.

The local name was "varikoz."

Lemur fulvus rufus Audebert. This lemur was common about Tabiky in the low dense brush, the wooded plains, and the gallery forest.

On November 16, 1929, at Tabiky I watched a party of six that were quite unaware of my presence. After a time they descended to the ground and walked about, finally disappearing in the brush. There was a favorite fruit tree near the camp where a party of these lemurs used to come to feed just at dusk.

On November 12, 1929, I shot a female carrying a young one from a party of five or six. Most of the others fled but when the young one, which was unhurt, started to call, another female with one young left her place of concealment in a nearby tree and came up close through the low bushes, attracted by the call of the young one that I had. She was carrying her young in the same manner as *L. f. collaris*, and appeared to be considerably inconvenienced by her burden. When climbing over branches the female frequently slipped and had to pull herself up. Possibly she had not fled as had the others because of this extra weight. Several other females carrying young were seen at Tabiky during November.

Lemur mongoz coronatus Gray. Very common in the dry wooded areas of the northern savanna, sometimes in rather low dense brush; found also in dry forest on the slopes of Mt. d'Ambre, up to about 800 meters. It was absent, however, from the humid forest on the summit.

In habits and voice this species is much like *L. fulvus*. The animals were very tame and the natives sometimes killed them with sticks.

On September 27, 1930, near Vohemar, DuMont and I saw a party of seven crowded together on a large branch. The sun had not yet risen high enough for its rays to fall on them and they appeared to be huddled together for warmth, as though they had spent the night that way. They were sitting on their haunches on a large branch that was nearly horizontal, their noses between their paws, and their tails curled forward under their bodies and up over their backs. At our approach they roused themselves and raised their heads to watch us but though we passed almost under the tree they displayed no fear whatever.

At Tarakibany, on November 11, 1930 I saw a party of five, two of which were females each with a single young. The young were clinging to the underside of the mothers' bodies about the loins, with their heads up on one side and their tails on the other.

Lemur rubriventer I. Geoffroy. This diurnal lemur was found in small parties similar to the groups of *L. fulvus*. One party contained at least four adults and five young. To the west of Andapa, during the last of August and the first of September, eight young, one quarter grown or smaller, were taken with the adults. On two occasions females were found to be carrying two young. In one of these that I examined, they were carried as is the single young of *L. fulvus*, clinging crosswise to the underside of the body above the hips. One had its head up on one side, the other on the opposite.

Possibly two is the usual number of young in this species, for when shot the female sometimes drops one or both of the young, and they could easily escape observation.

Lemur macaco Linnaeus. The habits and call of this lemur are much like those of *L. fulvus*. The parties observed were much larger than those of that species, containing sometimes as many as 18 individuals—males, females, old, and young. They were always very tame. The native name is "akomba."

Lemur variegatus Kerr. Near Maroantsetra (two days northeast) individuals in the red phase, the only phase seen there, were common. The variegated lemur is diurnal and arboreal, usually seen in pairs, walking along horizontal branches or springing from limb to limb. The call was often heard during the day, a "qua" quickly repeated eight or ten times and almost running into a trill. One nearly overhead in the forest gave a low growling call. None of the females contained embryos and no young were seen during June and July.

The local name for the red phase is "varimena" (the red lemur), while near Maroantsetra, where the white phase occurred, it is called "varikandra."

Lepilemur ruficaudatus Grandidier. The "hattock," as the natives call it, is apparently largely nocturnal, for I found it by torch-light in gallery forest at Tabiky; but one bright mid-afternoon a native pointed out one on a limb high up in a tall tree. I shot it and secured not only an adult female, but also a well grown young. The animals probably travel like *Propithecus*, by springing from upright to upright, for the live specimens that I had preferred to cling to uprights. It was surprising the distance they could spring with little apparent effort. The supporting parts of a shelter under which I worked were six feet apart and a hattock could spring from one to another with very little loss of height.

While traveling through a dry wooded area near Tsarakibany on the morning of November 11, 1930, I saw a *Lepilemur* looking out of a small opening in a tree trunk. The cavity was about twelve feet up and apparently just big enough to hold the animal, for it could not withdraw from sight. It took some time to prepare a noose on the end of a stick and after several ineffectual attempts I was able to slip the cord over one paw, but in the meantime it made no effort to start out of the cavity. When I finally pulled it out of the hole it squalled loudly and, when I handled it, attempted to bite savagely.

Propithecus verreauxi deckenii Peters. This *Propithecus* was common in the country from Namoroka to the Mahavavy Rivers, and a number apparently of the same subspecies were seen between the Mahavavy and Betsiboka Rivers. Schwarz (1931, p. 424) gives the Mahavavy River as the northern limit of its range, *P. v. coronatus* of A. Milne-Edwards replacing it there. These two forms could be distinguished in life, I think.

This is a common, diurnal animal, found in parties of sometimes as many as nine individuals. It frequented the heavy gallery forest, the lower, dryer forest, and at Soalala I found a party in the coast mangroves. Their mode of progression in the trees is like that of *Indri* rather than that of *Lemur*; they cling to the sides of vertical branches and spring from upright to upright. Largely arboreal animals, they sometimes descend to the ground as they did near Soalala when I startled a party in a point of woodland. To get to the next tree they had to descend to the ground and take a few bounds over the sand, jumping with their hind feet, not touching their forefeet to the soil. We found them rather tame here and easily approached.

Mr. A. Michailoff, whose guests we were at Ambararatabé near Lake Kinkony, had three tame *Propithecus*; one male, all white in color, and two females, gray on the back. He told us that his predecessor had kept these in captivity and when he left they had been liberated. When Mr. Michailoff arrived they were full grown and quite wild but he had succeeded in making them very tame by regularly putting out food for them. The favorite food was banana, but rice was usually given them and they also ate bread.

The rice was sometimes eaten from the plate but if lumpy the lumps were held in the hand, as were bananas. The thumb usually was not opposed when holding anything, but could be, as I saw when a *Propithecus* grasped the edge of a door. After eating, the palm of the hand was cleaned by licking.

The male was much bolder than the females. It could open the screen door and often came into the house, as did all three when the door was open. They jumped on to the chairs and on to the table where they would even take food from the plates.

The *Propithecus* allowed Mr. Michailoff to pick them up and caress them; they sat on his arms or on his head, but were intolerant of natives and shy of strangers. Mr. Michailoff warned us that the male had bitten strangers several times, but I paid little attention. Once, as I was watching the antics of the two females the male bounded up, seized my hand in his paws, and began to chew my skin. His teeth were not very sharp, and he succeeded in doing little damage beyond breaking the skin. Several times after that the male came hopping up, apparently ready to spring on me, but he never obtained another favorable opportunity.

These animals were most at home in the trees about the place, or on the roofs of the houses, but they dropped to the ground without hesitation and came across the thirty meters or so of level yard that separated the house and the trees. On the ground they traveled upright, on the hind feet, the legs fully extended. Progression was by a series of hops, of about four feet each, the body held usually somewhat sideways to the direction they were going, and after a few jumps the position of the body would be reversed so that now one foot and now the other was forward. The arms were held in front of the body and moved in unison with each jump. When the animals were traveling slowly, they sometimes took a few waddling steps. At no time did they travel on all fours, though they sometimes sprang from one sitting position to another.

About the house, they easily jumped from one to another of the posts of the veranda, which were 200 mm. square and 4 meters apart. They jumped with no apparent effort, from a sitting position, and with no apparent preparation. They jumped to the edges of open doors and to the chairs and tables as if impelled by a spring. In the trees their attitudes were grotesque. They sprawled about on the branches, sitting on a limb with three legs extended and holding a branch above with one foreleg. Sometimes they lay on a branch with their legs hanging down each side, sometimes they clung to the sides of a vertical trunk or sat in a crotch. Sometimes when descending to the ground they held on to the lowest branch with a single fore paw before dropping to the earth. When sitting on the ground the body was often held somewhat upright and the legs more or less extended in front. They occasionally called a weak "wok wok."

They enjoyed the morning sun and often sought a sunny place in which to sit. Though sometimes seen sitting straight upright so that the sunlight would warm their underparts they were not seen to spread their arms as did *Lemur catta*. A fly perched on the head of one was driven away with an amusing forward stroke of the paw.

Propithecus verreauxi verreauxi Grandidier. The brown-capped *Propithecus* was very common in the wooded areas of the southwest. A diurnal, arboreal creature, it was usually seen in parties of five to eight. Like the other members of this group it clings to upright limbs and jumps from vertical to vertical branches and several times I saw one back awkwardly down a tree-trunk. Once I found one in an isolated tree in the savanna which it must have reached over the ground, and another time I saw one in gallery forest hop a short distance on the ground like the subspecies *deckenii*. A young one one-third grown that I kept for a time usually hopped like a frog when on the ground.

When resting in the trees they sprawled out in grotesque poses like *P. v. deckenii*. Sometimes one sat in a crotch where it was not necessary to hold on at all. When the animal was at rest the tail was sometimes curled up like a watch spring and this was

usually the case with a young one being carried by a female. The young one I had alive often did this.

Active only in the daytime, they welcome the first rays of the sun and parties were often seen in the tree-tops sprawled out sunning themselves, sometimes even resting in a dead tree the better to enjoy the sun. They were usually not at all wild and could be watched at close range. When nervous one frequently threw its head back, muzzle pointing upwards, and then brought it forward again without uttering a sound. When disturbed they uttered a low growling noise. Another louder call was a "wok-wok-wok." Sometimes when I fired a shot near a party of these animals the whole group broke into a chorus of these calls, and the same thing happened near Tulear when the automobile in which I was riding passed a group in the trees by the roadside.

Green leaves of trees are probably their staple food. Stomach contents were too finely ground to be identified but the animals were often seen to feed on leaves and the young one I kept for a time ate them eagerly. This captive, however, about one-third grown, did not thrive on a diet of rice, honey, and leaves.

Numbers of females were seen with young, a single one in each case, and these were usually in bands of other adults, though occasionally accompanied by only a male. Until at least one-third grown the young travel crouched on the back of the mother, though possibly when very small they cling to her underside. The added weight of the young sometimes made the female avoid the longer leaps of six or seven meters that unencumbered animals took.

The native name was "schfick."

Indri indri Gmelin. We encountered the indri only in the heavy forest of the northeast, from sea level to 1800 meters, and found some surprising discrepancies in their range. About the Bay of Antongil they were common forty kilometers northwest of Maroantsetra, but at Maroantsetra, two days northeast, altitude 1000 meters, where the forest was equally heavy and continuous with that near Maroantsetra, none were found. Again, east and north of Andapa there is magnificent humid forest but none were heard in it, although west of Andapa, perhaps eight kilometers away in similar forest continuous with the former, they were common. These creatures are very noisy and it is unlikely their presence was overlooked.

They are diurnal animals, usually found on the larger branches of the trees. They usually went in parties of three or four, though sometimes a party of two and once a single animal was observed. Their mode of traveling was by leaps from vertical branch to vertical branch and they rested clinging to the sides of a vertical trunk, or sitting on a limb or in a crotch, like *Propithecus*, rather than walking along or crouching on horizontal limbs and jumping from branch to branch like the rest of the lemurs.

Their loud wailing calls carried far through the forest, and in the distance sounded not unlike the wailing of human voices. A whole party would burst into these calls, which would be continued for a few moments and then stop for a short time. Near Andapa (one day west), three or four parties would be calling during the morning so that their calls would sound almost continually over the forest. They called at almost any time during the day but possibly most frequently during mid-morning, and were sometimes heard during the night. One crippled animal that I watched raised its head and thrust forward its lips so that they formed a funnel, as it uttered the characteristic call that is surprising because of its volume. These calls had an elusive quality and though the direction from which they came might be determined with comparative accuracy, the distance of the calling beasts was extremely difficult to estimate. Because of the volume of the call, when attempting to find a party of calling indri, one would hurry through the forest to the place the calls seemed to have come from, and the calls would sound through the forest again, apparently as far away as ever. Sometimes this might have been due to the movement of the animals, for they travel with considerable

rapidity. At times, when we were traveling on the trails along the ridges above the forest, we could judge the rapidity of their travel by their calls, which sometimes started behind us, then apparently progressed parallel to the trail and soon sounded ahead of us in the forest.

One day on the trail a party of the animals broke into their loud wailing, apparently beside the trail, where we started to look for them; but the natives who were with us urged us forward, saying that they were still some distance ahead, and sure enough, we found them perhaps 150 meters from the trail. This party consisted of four adults and one young. The young, not one-third grown, was apparently carried on the back of the female, probably as with *Propithecus*, for when Dumont shot the female, he did not see the young that fell at the same shot. Though it was difficult to locate a party, it was usually possible, once we got within range, to collect several as they crouched on the branches, staring down at the intruder. On the occasion mentioned, we shot five of a party, while on another occasion, when alone, I shot three of a party of four. The fourth became alarmed and escaped through the tree-tops, taking such tremendous leaps from tree to tree across deep wooded ravines that pursuit was quite out of the question. On one bright morning two were seen sitting in the tops of the trees, apparently enjoying the sunshine as *Propithecus* was so often seen doing. These were both full-grown females with no indication of having bred. Possibly it takes several years for them to reach maturity. None of the females taken contained embryos; probably but one young is born at a time as on two occasions during August, at Andapa, one day west, one young not one-third grown was collected with its mother.

The eyes of the adult were yellow brown in color, those of the young were greenish. The flesh of these creatures was well flavored but usually so tough and hard even when the animals were fat that it was rather unsatisfactory food.

Many writers have said that this species is sacred to the Malagash. This certainly is not true for the Malagash as a whole, for the people of the south who had migrated to this part of the island had no objection to skinning or eating these creatures, and even the native Betsimisaraka and Tsimihity were quite ready to assist us in locating and shooting them, though the Tsimihity at Andapa, one day west, would not eat the flesh.

The indri is known as "babakoto" by the Betsimisaraka and the Tsimihity, and this name is probably used amongst the natives for this species alone, but the Europeans have come to use this word for any lemur, possibly because it is the easiest of the native names to remember. The natives who have had much contact with white people, particularly the Hova, use the word in this sense when talking to Europeans even in areas where the true babakoto does not occur.

Avahi laniger laniger Gmelin. The avahi is a nocturnal forest animal. On June 12, 1929, near Vondrozo, while motoring along the road through the forest in the early evening, we saw the reddish gleam of the eyes of two avahi reflected in the lights of the car from the tree-tops ahead. One of the animals was collected. Another was found asleep on the morning of July 16, 1929, clinging to the vertical trunk of a small tree about two meters above the ground. This was in a rather shady place in a forest glade well protected by small brush and overhung by a large forest tree. The tail of the avahi was curled up like a watch spring under it so that it could not be seen. The animal watched me intently as I approached and when I was within a few meters of it, started up the smooth trunk in a series of leaps. On the morning of July 19, 1929, natives brought news that they had located a party of lemurs. They guided me to an open shady place under the big trees in the dense forest where three of these little animals were clinging like tree frogs to the vertical trunk of a tree about 150 mm. in diameter. They were about four meters from the ground. Two were nearly opposite each other, the third was a little higher. All had the tails curled up out of sight. They allowed a close approach but all were watching me and as the first was shot, the other two made

off through the trees, traveling by leaping from branch to branch, clinging to uprights like *Indri* or *Propithecus* rather than like the other lemurs. One of those shot was a female with large embryos, one a female without embryos, and the third a male.

The avahi is called "varaka" by the Atamoor, a name probably used for most of the medium-sized nocturnal lemurs.

Daubentonia madagascariensis Gmelin. The only aye-aye seen was in the northwest. Throughout the rain forest of the east we found few who knew this creature, but in the Sambirano it was well known to the natives by name, though few had seen it. All of them said it fed on bamboo and was very ferocious. The absurdity of this last shows the necessity of careful evaluation of native information, even when the belief is wide spread. Our single specimen was collected at Ampasamena, a fishing village on the coast, in rather low hilly country. It was probably country that had once been wooded with humid forest but now was covered with open brush and low trees, and there was no area of real forest within several miles. This individual ventured into the village during the early part of the night and was walking about amongst the houses when found by a native, who impaled it on a fish spear. It was evidently not common or else not often seen as the chief of the village, a gray-haired old man who claimed to be the brother of a former Sakalava king, knew the beast by name but had never seen one before. It was universally known as "hi-hi."

CHIROPTERA

Eidolon dupreanum Schlegel & Pollen. At Ampotaka, on March 25, 1930, while hunting in the rich gallery forest along the Menarandra River, I was attracted to a roost of these bats by their squealing and grunting. There was a rather closely grouped mass of them containing perhaps 30 or 40 individuals, some five meters up in a shady place where the vines and branches were dense. They were continually climbing about the branches, using both their feet and the claws of their wings, and were squealing and grunting. They were forced into flight only with difficulty; the native with me had to push them off the branches with a stick. There was another group in a similar place about 30 meters away. From the first group I collected four males and from the second group a female. Some of the disturbed males lit in the branches above the group of females.

At Anorontsanga, in January, many of these bats were flying about the coconut trees in the early evening, lighting in the clusters of young coconuts, where I could see their eyes gleaming in the rays of the torch. The natives said that they ate the young coconuts.

Pteropus rufus E. Geoffroy. Numbers of roosts of the flying fox were found in western Madagascar, the roosts containing from sixty to over a thousand individuals. In the smaller roosts but a single tree was occupied; in the larger roosts a number of adjacent trees were used. The roosting trees were sometimes solitary trees in open savanna, sometimes trees in clumps of forest in the savanna or along a river, and the largest roost, of more than a thousand bats was on a little island in the harbor of Diego Suarez. The bats hung singly to the twigs and smaller branches of the trees and were often conspicuous from a distance. There was often considerable movement amongst them during the day, bats flying about or moving from limb to limb, and the squealing and chattering was sometimes audible for a considerable distance. Some individuals were easily disturbed by approaching the roost while others stayed in the tree, though I fired a shot nearby. Some of the disturbed bats sometimes flew about for hours, others alighted in distant trees and later returned to the original roosting place.

Their evening flights were striking; at Maromandia in February large numbers were seen flying inland; before dusk they were high, the lowest two or three hundred meters above the earth, the highest mere specks in the sky. As darkness came on the bats flew

lower and lower until at dark they were flying at the level of the tree tops. Apparently there was a large roost on the coast and the individuals that fed far inland started early and flew at a great height, while those that fed near the coast left their roosting place much later and flew low to their feeding grounds. Many large gum trees grew about the administration building and these were favorite feeding places.

One evening at dusk, while anchored in a dhow off the coast near Maromandia, we saw numbers of these bats start inland from their roost while a few flew toward little islands off shore, flying about 75 meters above the water.

The flying foxes were fairly common after dark at some places in the rain forest of the east but no roosts were seen there. Near Maroantsetra they were a regular article of food for the natives and every day a few were seen hanging up outside one or another of the village houses.

These bats were captured by means of a large net, woven from raphia, hung between two uprights, that were often the leaf stems of the raphia palm, lashed to the tops of trees so that the net hung 25 to 40 meters above the ground. The net was usually placed across a trail or over a clearing in the forest where the bats had been seen to pass. When a bat flew into the net, the native watching below released the net by a system of cords running through loops, and the net and the bat fell to the ground. At one net that I visited in the early evening, a native had caught but a single bat that he was keeping alive by twisting its wing through a forked stick to which it was allowed to cling, apparently in the hope that its squealing and growling would attract others. From two to four bats seemed to be a usual night's catch.

Three females taken October 22, 1929, 80 kilometers east of Tulear, each contained two large embryos.

The natives called these bats "fanihy."

LITERATURE CITED

DELACOUR, JEAN. 1930. Notes de Madagascar. L'Oiseau et la Revue Française d'Ornithologie, vol. 11, no. 2, pp. 65–77; no. 3, pp. 160–179.

——— 1932. La mission zoologique Franco-Anglo-Américaine à Madagascar. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 4, no. 3, pp. 212–221. April, 1932.

RAND, A. L. 1932. Mission Franco-Anglo-Américaine à Madagascar. Notes de voyage. L'Oiseau et la Revue Française d'Ornithologie, n.s., vol. 2, no. 2, pp. 227–282.

SCHWARZ, ERNST. 1931. A revision of the genera and species of Madagascar Lemuridae. Proc. Zool. Soc. London for 1931, pt. 2, pp. 399–428. June, 1931.

The American Museum of Natural History, New York, N. Y.

NOTES ON THE BREEDING BEHAVIOR AND FERTILITY OF NEOTOMA FUSCIPES MACROTIS IN CAPTIVITY

By Fae Donat Wood

During 1933 and 1934, sixty-one specimens of the San Diego wood rat, *Neotoma fuscipes macrotis* Thomas, have been captured alive and kept in the laboratory for periods varying from a few days to two years. In the course of work with these rats, especially in an attempt to obtain young laboratory-bred specimens for experimental purposes, various observations on their life history and behavior have been recorded.

All specimens were obtained from San Diego County, California, with the exception of one which was taken in Los Angeles County. The writer extends grateful acknowledgment to A. E. Peterson, P. A. McEwen, and S. F. Wood for assistance in trapping, and to Professor J. Grinnell and Dr. S. B. Benson of the Museum of Vertebrate Zoology for identification of specimens.

The methods of trapping, and care in the laboratory have been essentially the same as those described in an earlier publication (Donat, 1933), except that in this case the rats were kept in tiers of cages in a large, six-tier-capacity metal rack, having six cages (9½ x 15 x 12 inches) in a tier. Cages of this size are usually satisfactory for these wood rats as they are more docile and less apt to escape when the cage front is opened than are the less tractable Portola wood rats (*Neotoma fuscipes annectens* Elliot), which the writer used in earlier experiments.

SEASONAL BREEDING ACTIVITY

Five female individuals, pregnant when trapped, gave birth to young on February 1, 7, 16, and 20, and March 4, 1934. This indicates that the breeding season with this subspecies is earlier than for Portola wood rats from Berkeley, since in the latter subspecies the earliest comparable date recorded was April 6. Gander (1929) reported having captured a pregnant female *macrotis* as early as December 12.

As the breeding season approaches the testes of the males increase in size. At the height of the season they are several times as large as during the quiescent period and are usually scrotal. During quiescence they are about the size of a navy bean and are palpable within the body cavity. No actual measurements were taken. Examination of rats which had been in the laboratory at Berkeley for about six months showed the testes beginning to enlarge as early as December 21. It is possible that in their more southern natural habitat this development takes place earlier.

Young rats, approximately six months old, have shown testicular enlargement during the spring season, suggesting that they mature at that time. However, a young male in this condition failed to mate with four different females on six different occasions, and a six-month-old female likewise failed to mate on four occasions with two different males. Whether this failure was due to adverse laboratory conditions of whether it indicates that the rats are not sexually mature during the first season is questionable. The former alternative seems probable, although the rats appeared to be in fine physical condition.

Observations on females of this species corroborate the writer's findings on Portola wood rats (1933) concerning closure of the vaginal orifice by a membrane in immature specimens, and permanent disappearance of that membrane in adults. Five specimens

caught and examined in August, 1933, showed the membrane present, as did also a four-month-old female examined in July. Five mature specimens, caught and examined in August, 1933, failed to show the membrane. A six-month-old female, examined on December 28, 1933, showed no membrane. No male had associated with this female since separation from a young male of the same age about three months previously, so it appears that the vaginal membrane may break down naturally with the onset of the breeding season. That this membrane is of relatively delicate structure is shown by the fact that it can be broken by very light pressure with a probe.

BREEDING EXPERIMENTS

Between December 28, 1933 and April 9, 1934, 10 males and 21 females were paired together in 62 different combinations. Either the male was placed in the cage of the female, or *vice versa*, in the rack described in the introduction. The pairs were left together for from one or two nights to several weeks, depending upon their behavior. Only males with conspicuously enlarged testes were used.

The females were examined every morning for spermatozoa by gently inserting a small spatula into the vagina and removing some of the material to a slide containing 0.85% saline. Spermatozoa, when present, could easily be detected in such a preparation.

Wood rat spermatozoa resemble closely those of the Norway rat, having a sharply curved, fishhook-like head, and a long, slender tail. They are about 125 microns long.

In only 17 of the 62 attempted matings were spermatozoa discovered in the vaginas of the females. The first were seen on January 26, and the last on April 12. The vaginal plug, such as occurs in female Norway rats after copulation, was not present in the wood rats. In some cases there were enormous numbers of spermatozoa but they were always deep in the vagina.

When preparations were made for spermatozoa, the cellular contents of the vagina also were examined. The writer has not come to any conclusion as to the exact nature of the oestrous cycle in wood rats. The usual examination, whether copulation had occurred or not, revealed a small to moderate amount of thin, pearly mucus containing in order of abundance: leucocytes, epithelial cells, and a few cornified cells. In one female the cornified cells were very numerous on one occasion, suggesting oestrus, but she seemed very antagonistic toward the male, and mating did not take place.

In a few females the vagina became infected with bacteria. Results were fatal in all cases except one which was treated with dilute lysol. The infected rats seemed to die of a generalized septicemia, with death preceded by loss of appetite, weakness, and coma. Sterile instruments were always used in vaginal examinations, so the origin of the infection is uncertain.

The reactions of the paired rats toward each other were interesting. Though the behavior varied somewhat with individuals, certain characteristic reactions occurred repeatedly. In a large number of cases there was considerable fighting. It is probable that the small size of the cages was a great disadvantage, since it was difficult for the pursued to escape the pursuer. Five females were killed, and two males so badly injured that it was considered advisable to chloroform them. In some cases severe flesh wounds were inflicted, especially on the back and legs, and in other cases one rat seemed to dominate and frighten the other to such an extent that death resulted. That these rats, and still more the Portola wood rats, are vicious fighters in their natural habitat is evidenced by the slit ears and scarred bodies of trapped specimens, especially those taken in the breeding season.

It is perhaps trite, but significant, to state that individual animal personalities differ greatly. Some of the wood rats react in an inquisitive and friendly manner, both toward man and members of their own species, while others have the furtive, distrustful attitude commonly seen in wild Norway rats. The former type has been most success-

fully used for breeding in this laboratory, while the greatest number of casualties have occurred in the latter.

It may be of interest to describe a typical case of the behavior of two rats toward each other, so as to illustrate certain characteristic reactions. In early January, 1933, a nine-month-old virgin female was placed in the cage of a male of the same age. Both rats had always been tame and gentle. The vaginal membrane of the female was absent, and the testes of the male were enlarged but not scrotal though they became scrotal shortly afterwards.

First they stood still and sniffed toward each other, then they jumped at each other and ran rapidly about the cage. Then they stood on their hind legs, facing each other, each with forepaws on shoulders of the other, vibrissae quivering and noses almost touching. Sometimes one would nip at the face and neck of the other and emit shrill squeaks. This tense attitude would be maintained until one made a lunge at the other and gave chase again. In this particular case the female appeared to be the pursuer, though in some other cases the male has been the aggressor. The male crouched in a corner of the cage in a characteristic defense attitude. He sat, more or less on his back with all four feet in the air, his mouth partly open, vibrissae quivering and his eyes narrow slits, watching the female. She waited until he relaxed his watchfulness, then cautiously approached, sniffing his fur while he eyed her with seeming suspicion. She sniffed his nose, back, and genitals, then began licking these various parts. All this was tolerated by the male, until she began licking him excitedly and ended by giving his shoulder a sharp nip with her teeth, upon which he sprang at her, and the chase was on again. In running about the cage, the progress was so rapid, and there was so much bumping against the walls and tumbling about that it was difficult to make out which was chasing and which being chased. This activity was followed by a more quiet period in which the rats rested, nibbled grain, and occasionally followed each other about. The female was especially solicitous of the male, frequently licking his face, ears, paws, and other parts. Sometimes he seemed to relax and enjoy the attention; at other times he appeared annoyed and would walk away from her.

The above behavior was observed in the morning. Apparently, the rats were still more active at night, as evidenced by the amount of shavings and other débris from their cage which was scattered about on the floor the next morning.

Although these rats remained together for four days, mating did not take place. At the end of that time the male looked so bedraggled that the female was returned to her own cage. Though no serious wounds were inflicted, it was obvious that the two were not compatible, since the male stayed in an opposite corner of the cage from the female whenever possible. In other more successful matings the two rats usually curled up together in the same nest.

In one pair of rats copulation was observed. This occurred in the early part of the afternoon, within five minutes after the male was placed in the cage of the female. After some preliminary sniffing, the female placed herself directly in front of the male with her tail curved to one side. The male responded immediately. Eight copulations, each lasting about five seconds, took place within less than ten minutes. Each rat licked his own genitals after copulation, and the female stretched her body in a very characteristic manner each time. After the eighth copulation the female again presented herself to the male, but was ignored. At this time the male was removed from the cage, and the female examined for spermatozoa which were found in large numbers.

The cellular content of the vagina was composed of very numerous epithelial cells, a few leucocytes, and very few cornified cells, in contrast to the usual picture in which the leucocytes predominate. Judging by her behavior, this female must have been in heat. However, she did not give birth to young, though she was a sleek, healthy-appearing animal.

A small amount of the material containing motile spermatozoa was removed from the vagina of this female with a pipette and placed in the vagina of a female Portola wood rat to see if these two subspecies could be crossed. The vaginal content of the Portola wood rat at the time showed numerous leucocytes, a few epithelial cells, and a few cornified cells. Results were negative.

In some of the females in which spermatozoa were found, there was a subsequent swelling of the mammae which led to the tentative conclusion that these rats were pregnant. In several of these the swelling subsided and no young were born. In two cases, however, litters were born on March 29 and May 6, respectively.

Since vaginal examinations had shown when copulation took place, and since the females were separated from the males as soon as sperms were found, it was possible, in the two cases, to determine definitely the gestation period. In both cases the young were born thirty-three days after copulation.

In an earlier publication (1933) it was stated that "the probable gestation period in *Neotoma fuscipes annectens* is twenty-three days." This conclusion was based as stated, on behavioristic evidence and not on actual knowledge of when mating occurred. It is probable, in view of the thirty-three-day period in *N. f. macrotis*, that the gestation period estimated for *N. f. annectens* was incorrect.

An abnormal number of inguinal mammae was discovered in one San Diego wood rat, the total number being five, instead of four. There were three on the right side, the middle one being smaller than the others. On the left side there were the usual two.

DESCRIPTION OF YOUNG

Eight litters of young San Diego wood rats have been born in this laboratory, three from females bred in captivity and five from females that were pregnant when caught. Two of the litters contained three, and six of them two individuals.

The young are hairless when born, except for the vibrissae, and are dull red in color. The dorsal parts soon become pigmented with dark gray. Weights of three litters, each composed of one male and one female, were: 13.3 and 13.3 grams; 13.3 and 13.8 grams; and 12.5 and 12.8 grams. In the last two litters the heavier individual was the male. No measurements were taken, but the young are definitely larger than those of Norway rats. In three litters of two each the eyes opened on the 11th, 14th, and 16th days, respectively. The young soon become covered dorsally with soft, gray fur, the ventral parts being white. Even before the eyes open the young are capable of coördinated leg movements, sufficiently effective to enable them to evade, temporarily, the hand of their captor.

Most of the young born to females that were pregnant when trapped were either neglected or eaten. In one case the female was indifferent to her two young, leaving them in the cold, but permitted them to suckle when they were placed under her. By placing them under her twice a day and every evening until they were able to crawl about and find her themselves one of them was saved. The other was eaten. Of the six young born and bred in the laboratory, one was eaten by the mother.

If the young are handled frequently they become quite tame and, even after reaching adulthood, make no attempt to bite when picked up, though they do not seem especially to enjoy being handled or petted, however gently it is done. Generally, the young are less cautious than the adults. One young one was always willing to come to the front of the cage to sniff my finger or be stroked, but on two such occasions the mother took it in her teeth by the skin of the neck and removed it to a [illegible]fer distance. Usually the young are picked up by the side of the neck or shoulder rather than the back so that the ventral side of the body is toward the mother.

Drumming with the forepaw has been noted in *Peromyscus* (Seton, 1920, and Svihla, 1932); a similar but less rapid drumming with the hind foot was observed in an immature San Diego wood rat.

SUMMARY AND CONCLUSION

1. Sixty-one specimens of *Neotoma fuscipes macrotis* were captured in San Diego and Los Angeles Counties and their behavior observed in the laboratory.

2. Thirty-one rats were paired in 62 different combinations for breeding between December 28, 1933, and April 9, 1934.

3. In the 62 trials, 17 pairs mated, as indicated by microscopical examination of vaginal contents of the females.

4. The behavior of a pair of rats is described.

5. One pair of rats were observed to copulate eight times in less than ten minutes.

6. From the 17 matings, only two females gave birth to young.

7. In two cases the gestation period was 33 days.

8. Observations on the appearance and behavior of the young are recorded.

9. It may be concluded that, in small laboratory cages, San Diego wood rats do not breed readily, and in cases where mating does take place, the fertility is low.

LITERATURE CITED

DONAT, F. 1933. Notes on the life history and behavior of *Neotoma fuscipes*. Jour. Mamm., vol. 14, pp. 19–26.

GANDER, F. F. 1929. Experiences with wood rats, *Neotoma fuscipes macrotis*. Jour. Mamm., vol. 10, pp. 52–58.

SETON, E. T. 1920. Notes on the breeding habits of captive deermice. Jour. Mamm., vol. 1, pp. 134–138.

SVIHLA, A. 1932. A comparative life history study of the mice of the genus *Peromyscus*. Univ. Michigan Mus. Zool., Misc. Publ. No. 24, pp. 5–39.

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DEVELOPMENT AND GROWTH OF THE PRAIRIE DEERMOUSE, PEROMYSCUS MANICULATUS BAIRDII

BY ARTHUR SVIHLA

For the past three years a comprehensive comparative study of the development and growth of different subspecies of deermice has been in progress. It is hoped that eventually as many as possible of the forty-odd subspecies within the genus *Peromyscus* will be studied. The results of such a study will not only present new data upon the actual development and growth of a large series of native wild mice but will also offer a means of comparing the development and growth of the mice of the various subspecies at comparable ages. Thus important similarities and differences between the races will be revealed. Such data will also aid in elucidating the problem of speciation and the trend of evolution in this group of rodents.

Work so far has been reported on the development and growth of the mice of the subspecies *Peromyscus maniculatus artemisiae* (Svihla, 1934). The present paper deals with comparable data obtained for the subspecies *P. m. bairdii*.

The prairie deermouse, *P. m. bairdii*, inhabits the prairies of the mid-western states and is a smaller, darker form than *P. m. artemisiae*. The latter occupies the sagebrush regions of the western states and is distinguishable by its longer tail and body and paler pelage.

Size and growth in any living organism are dependent upon two sets of characters, intrinsic or genetical and extrinsic or environmental. In this work the extrinsic or environmental conditions are kept constant so that any differences that may appear may be considered as due to inherent characters.

The original stock of deermice whose progeny were used in this study consisted of six pairs of *P. m. bairdii* kindly sent me by Dr. L. R. Dice of the University of Michigan, who secured them from Sandpoint, Michigan. These mice were kept under conditions identical with those in the case of the subspecies *P. m. artemisiae*; in fact, the cages were placed side by side in the greenhouse which was used as a laboratory. They were fed the same food, which consisted of a balanced diet of two-thirds ground whole wheat, one-third powdered whole milk, plus two per cent iodized salt. In addition to this basic diet, either lettuce trimmings, germinated wheat, or apples were provided at all times. Water was furnished by means of drop bottles. Thus the environmental conditions were kept constant for the two subspecies. None of the animals became excessively fat or showed any evidence of undernourishment or disease. Data from a total of 39 mice or ten litters, which ranged in size from one to seven and averaged 4.0 mice per litter, were obtained in this investigation. The total number is small, but large enough to be of statistical value.

The methods for measuring and weighing the mice as well as calculating the data were the same as those reported in the work on *P. m. artemisiae* (Svihla, 1934). The measurements and weights were all taken by the author in order to maintain any personal error as constant. Observations on the appearance at birth and the subsequent development of the young mice were recorded for each litter. The unfolding of the ears, development of the hair and the opening of the eyes were also noted. Measurements of the total length, tail length, length of ear from notch, length of hind foot, and weights were taken by means of a steel metric rule, vernier calipers, and scales sensitive to 50 mg. These measurements and weights were taken at two-day intervals from birth to 58 days of age.

It has been shown in a previous investigation (Svihla, 1932) that the newly born young of all the subspecies of deermice of the subgenus *Peromyscus* studied were similar in appearance. They were all hairless, blind, pink in color, and had their ears closed by the pinnae folding down over the otic opening. The dorsal parts of the young mice became heavily pigmented within a short time, usually 24 hours, and in two to four days dark hair was conspicuous. The young mice of the subspecies *P. m. bairdii* did not differ from the others in these respects. When the mice were from two to four days

old the pinnae of the ears unfolded and became erect. The eyes usually opened on the 14th day. The regular 23 day gestation period was usually prolonged to about 25 days when the pregnant female was nursing a litter (Svihla, 1932). When the second litter was born the mice of the first litter were forcibly weaned, since the mother would no longer have anything to do with them. The development of the young *P. m. bairdii* was similar to that of the young *P. m. artemisiae.*

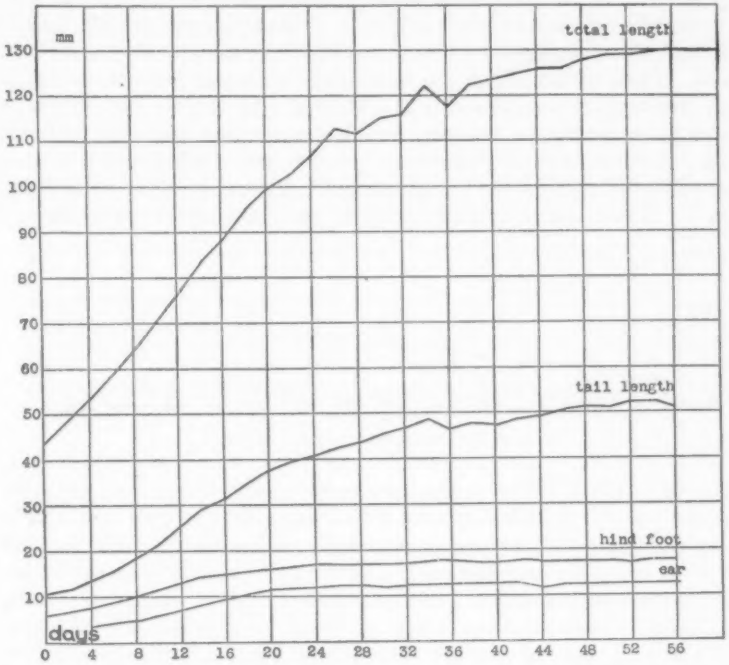

FIG. 1. MEAN GROWTH CURVES FOR TOTAL LENGTH, TAIL LENGTH, HIND FOOT, AND EAR FROM NOTCH

The total lengths of the newly born *bairdii* varied from 40 to 53 mm. with a mean of 43.62±.26 mm. Increase in total length was most rapid up to the 25th day, during which time the mean total length had more than doubled. At the end of this interval the young mice were usually weaned. From the 25th to the 58th day of age there was a marked slowing down in the rate of increase. At 58 days of age the mean total length was 130.00±.84 mm. or treble that at birth. This closely approached adult size or 145.75±1.32 mm., the mean total length of the parents of these mice. Dice (1932) has shown

that growth in this subspecies continues slowly but at a perceptible rate even after two years of age (fig. 1).

The total length curves of *bairdii* and *artemisiae* are very similar in that the greatest increase in rate takes place during the first 25 days after which there is a slowing down. However, it is to be noted that the curve for *bairdii* comes at a lower level on the chart, thus indicating a similar rate of growth but for a shorter mouse. The difference in size of these two subspecies is apparent even at birth, for the mean total length of *bairdii* at birth is 43.62±.26 mm. while that for *artemisiae* is 45.57±.32 mm. This difference between them is of statistical importance since it is almost five times the probable error of the means. These measurements are statistically important for such a series of mice, although the measurements of individual mice of these two subspecies tended to overlap during the early period of life. After about the 36th day of age, however, the size differences between the two subspecies became more and more marked and overlapping of individual measurements disappeared. This is indicated by the widening space between the curves (fig. 3.).

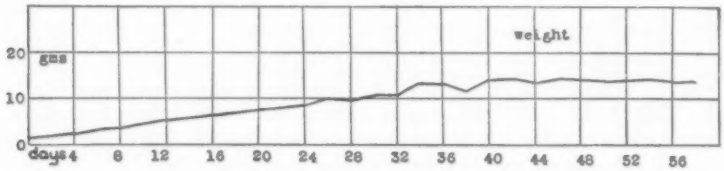

FIG. 2. MEAN WEIGHT GROWTH CURVE

The tail lengths of the newly born *bairdii* showed comparatively little variation, ranging from 9 to 12 mm. with a mean of 10.49±.06 mm. As in the total length curve, increase in tail length was most rapid up to the 25th day, after which the rate decreased. By the 25th day the mean tail length had increased four times that at birth, or 42.60±.69 mm. A gradual slowing down occurred after this time so that at 58 days of age the mean tail length was 51.00±1.15 mm. or only five times that at birth. At this time the tail lengths were almost adult in size, since the mean of parents' tails was 59.38± .83 mm. in length (fig. 1.).

Exactly as the curve of the total lengths, the tail length curve of *bairdii* parallels that of *artemisiae* but again at a lower level so that the shorter tail length of *bairdii* is obvious even at birth. Overlapping of individual tail lengths may occur during early life, but as the mice grow older the tail lengths become more and more distinct (fig. 3.).

The difference in tail length between *artemisiae* (11.30±.08 mm.) and *bairdii* (10.49±.06 mm.) at birth is statistically significant since the differences are more than 15 times the differences between the probable errors of the means.

The length of the hind foot of newly born *bairdii* varied from 5.6 to 6.6 mm. with a mean of 6.15±.28 mm. By the 25th day the mean length was 16.54± .63 mm. or practically adult in size when compared with 17.81±.56 mm., the mean hind foot length of the parent mice. Only slight growth occurred after the 25th day (fig. 1.).

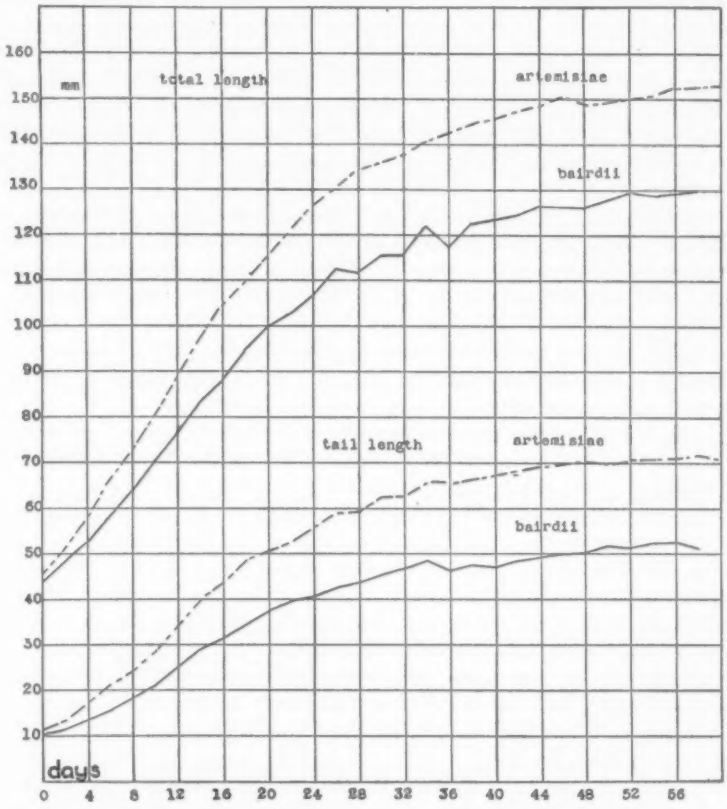

FIG. 3. COMPARATIVE GROWTH CURVES OF P. ARTEMISIAE AND P. BAIRDII

Compared with *artemisiae*, the mean hind foot length of *bairdii* is not significantly different either at birth (6.44±.35 mm. and 6.15±.28 mm. respectively) or at the end of the first 58 days of life (19.55±.65 mm. and 17.60±.96 mm. respectively). The adult hind foot measurements of these two subspecies also show no statistical difference between them, i.e., 19.38± .63 mm. and 17.81±.56 mm.

At birth the pinnae of the ears were folded down over the otic openings. During the second day the pinnae began to unfold and by the fourth day were erect. At this time measurements were first taken from the notch to the tip of the ear and these varied from 2.9 to 4.0 mm. with a mean of 3.42±.50 mm. By the 25th day the ears were 12.10±1.99 mm. or approximately adult in size when compared with the ear lengths of the parents which were 13.23±1.05 mm. (fig. 1.).

Again, as in the comparison between the hind foot lengths of these two subspecies, there is no statistical difference between the ear lengths of *bairdii* (3.42±.50 mm.) and *artemisiae* (4.49±.48 mm.) at four days of age or at the end of the first 58 days of life (13.43±.74) and 16.39±1.10 respectively). The growth curves for the ear lengths of these two subspecies practically coincide.

In weight the newly born *bairdii* varied from 1.3 to 1.9 gms. with a mean of 1.62±.13 gms. The rate of increase was a gradual but constant one, the mice gaining about .5 gms. a day. At 58 days of age the mean weight of the mice was 15.45±.67 gms. (fig. 2). Compared with the weights of *artemisiae*, there was no statistical difference either at birth (1.80±.08 gms. for *artemisiae* and 1.62±.13 gms. for *bairdii*) or at 58 days of age (17.99±2.87 gms. for *artemisiae* and 15.45±1.67 gms. for *bairdii*). The weight curves of the two subspecies are very similar.

Comparing the development and growth of the mice of the two subspecies *P. m. bairdii* and *P. m. artemisiae* at birth and during the first 58 days of life, the results may be summarized as follows:

At birth the general appearance of the young mice of the two subspecies was the same.

The unfolding of the ears (two to four days); pigmentation (24 hours); appearance of hair (two to four days); opening of the eyes (usually 14 days for *bairdii* and 15 days for *artemisiae*); and weaning (about 25 days) were all approximately the same for the two subspecies.

The mice of both subspecies grew most rapidly during about the first 25 days, after which time the rate of growth gradually decreased. The ears and hind feet of both subspecies reached mature size much earlier than the tails and total lengths.

The curves for the ear lengths, hind foot lengths, and weights for the two subspecies were very much alike. However, the curves for tail lengths and total lengths were notably different. Those of *bairdii* were similar to those of *artemisiae* but came at a lower level, thus indicating a shorter mouse. Although individual measurements of tails and total lengths overlapped during early life, as shown by the proximity of the two curves, these became more and more distinct as the mice approached adult age. These measurements, however, showed a statistically significant difference even at birth. Since the length of the hind foot, ears, and weights of the two subspecies were similar,

the tails were the significant parts of the total lengths which differed. By actual computation the mean body lengths (mean total lengths minus mean tail lengths) at birth and at 58 days of age differed by less than 1.5 mm. Thus the chief difference between the two subspecies (aside from pelage and distribution) is the fact that *bairdii* has a shorter tail. This inherent difference is apparent even in the newborn mice and thus becomes an important diagnostic character separating these two subspecies.

LITERATURE CITED

Dice, L. R. 1932. Variation in a geographical race of the deermouse, *Peromyscus maniculatus bairdii*. Occas. Papers. Mus. Zool., Univ. Michigan, no. 239, pp. 1–26.

Svihla, A. 1932. A comparative life history study of the mice of the genus *Peromyscus*. Misc. Publ. Mus. Zool., Univ. Michigan, no. 24, pp. 1–39.

——— 1934. Development and growth of deermice (Peromyscus maniculatus artemisiae). Journ. Mamm., vol. 15, no. 2, pp. 99–104.

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THE BREATHING RATE OF THE HIPPOPOTAMUS AS INDICATED BY ITS SUBMERGENCE PERIODS

By G. H. Parker

In 1932 I published some records on the length of time that the hippopotamus may remain under water, which showed that the average period was about 50 seconds, with a maximum of 1 minute and 22 seconds. These records fell far short of those reported by Pocock (1918a, 1918b), according to whom this animal might be expected to remain under water as long as half an hour. Since making my earlier observations I have had the opportunity of studying two other hippopotamuses, one in the Philadelphia Zoological Garden and the other in the National Zoological Park, Washington, D. C., with the following results.

The animal in the Philadelphia Garden was approximately 2 meters long and was observed in its tank of water, rising and sinking as it breathed. I was accompanied by Professor W. M. Wheeler and with watch in hand we together took a series of records of the animal's breathing. Of 10 periods of submergence the shortest was 30 seconds, the longest 1 minute, 18 seconds, and the average 53.8 seconds. The animal then rose above the water and remained so.

The second hippopotamus observed was in the National Zoological Park, Washington, D. C., and I am under great obligations to the Director of the Park, Dr. W. M. Mann, and to the keeper of the Zoo, Mr. W. H. Blackburne, for ample opportunity to study this animal. The creature was a male of

about 21 years of age, 20 of which had been spent in the Park. Its length was approximately 3 meters and its weight was estimated at 6000 pounds.

When I arrived at its pool, which was indoors, I was told that in consequence of repair work which was going on in its vicinity the animal was restive and nervous and indeed when loud noises were made such as heavy hammering and the like the animal was sure to submerge. During a period of disturbance of this kind I took 13 records, showing a minimum of 28 seconds, a maximum of 3 minutes, 50 seconds and an average of 1 minute, 19 seconds. The noise then ceased and after half an hour of quiet I took a second series of records, 11 in number, showing a minimum of 5 seconds, a maximum of 4 minutes, 30 seconds and an average of 2 minutes, 43 seconds, records which on the whole fail to justify the idea expressed by some writers that the hippopotamus tends to stay under water much longer when disturbed than when undisturbed.

TABLE I

Maximum, minimum, and average times of submergence in minutes and seconds of Hippopotamus amphibius Linn. as recorded by various authorities

AUTHORITY	DATE	MIN.	MAX.	AVERAGE	SIZE
Amédée-Pichot	1919	0:40	4:20		
Babák	1921	0:09	0:20		
Vevers	1926		3:00	0:40	Adult
Vevers	1926			0:20	Suckling
Parker (Hamb.)	1932	0:28	1:14	0:52	2 meters
Parker (Hamb.)	1932	0:23	1:22	0:49	2 meters
Parker (Phila.)	1934	0:30	1:18	0:54	2 meters
Parker (Wash.)	1934	0:05	4:40	2:14	3 meters

The hippopotamus was then fed, the water of its tank was changed, and it was finally allowed to reënter its pool. I then took a series of 25 records undisturbed in any way. The minimum period in this series was 30 seconds, the maximum 4 minutes, 40 seconds and the average 2 minutes, 31 seconds.

Combining these three series, 49 records in all, the minimum period is found to be 5 seconds, the maximum 4 minutes, 40 seconds, and the average 2 minutes, 14 seconds.[1] This average record is more than twice as high as the average for the Philadelphia specimen and those for the Hamburg specimens (table 1), but it is probably correlated with size, for the Washington specimen was about 3 meters long and the others each about 2 meters in length. It is well known that in general the breathing interval in mammals decreases with the decrease in size. This is illustrated in Vever's record for the hippopotamus

[1] The maximum period here recorded agrees well with the statement of Keeper Blackburne that after an almost life-long acquaintance with this animal he would place its maximum period of submergence at not over six minutes.

in which the suckling hippopotamus has an average submergence period of some 20 seconds as compared with two to three times that length of time for ordinary adults. This difference is also supported for aquatic animals by my records from the manatee, in which a specimen less than 2 meters long had an average submergence period of 4 minutes, 37 seconds and one 3 meters long had an average period of 12 minutes, 1 second (Parker, 1922).

The records of submergence periods for the hippopotamus presented in this paper, like those in my former article (1932a), give no support to the belief that the hippopotamus may remain under water for such long periods as half an hour. They lead to the conclusion, already expressed by Brehm (1902), that the maximum period of submergence for this animal is from four to five minutes. So far as one can see, the structure of the hippopotamus shows no very unusual adaptations to aquatic life such as is seen, for instance, in the cetaceans. The discovery by Gratiolet (1860) of circulatory sphincters in the blood-vessels of the hippopotamus may be a means, as pointed out by Irving (1934), of restricting the circulation in such a way as to limit temporarily the active flow of blood to the anterior part of the animal, particularly to the heart and brain, and thus to economize the store of oxygen in the lungs when the animal submerges. But even this adjustment is a very slight one in comparison with what is seen in truly aquatic mammals. The breathing activities of the hippopotamus seem to me to indicate its amphibious rather than its aquatic nature.

LITERATURE CITED

Amédée-Pichot, P. 1919. Les immersions de l'Hippopotame. Bull. Soc. Nat. Acclimat. France, vol. 66, pp. 297–300.

Babák, E. 1921. Die Mechanick und Innervation der Atmung. In H. Winterstein, Handb. vergl. Physiol., vol. 1, pt. 2, pp. 265–1027.

Brehm, A. E. 1902. Thierleben. Erster Abteilung. Säugethiere, vol. 3, Leipzig, 765 pp.

Gratiolet, P. 1860. Recherches sur le système vasculaire sanguin de l'Hippopotame. C. R. Acad. Sci. Paris, vol. 51, pp. 524–528.

Irving, L. 1934. On the ability of warm-blooded animals to survive without breathing. Sci. Month., vol. 38, pp. 422–428.

Parker, G. H. 1922. The breathing of the Florida manatee (Trichechus latirostris). Journ. Mamm., vol. 3, pp. 127–135.

Parker, G. H. 1932a. The normal period of submergence for the hippopotamus. Amer. Journ. Physiol., vol. 99, pp. 577–578.

Parker, G. H. 1932b. The respiratory rate of the common porpoise. Journ. Mamm., vol. 13, pp. 68–69.

Pocock, R. I. 1918a. The hippopotamus and duration of submergence. The Field, London, vol. 132, p. 348.

Pocock, R. I. 1918b. Submergence of the hippopotamus. The Field, London, vol. 132, p. 384.

Vevers, G. M. 1926. Some notes on the recent birth of hippopotamus (H. amphibius) in the gardens. Proc. Zool. Soc. London, pp. 1097–1100.

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BEE-EATING PROCLIVITIES OF THE STRIPED SKUNK

By Tracy I. Storer and Geo. H. Vansell

That skunks will, at times, visit apiaries and feed on hive bees is a matter of fairly common knowledge. This occurs in numerous places in California; in a few localities it is of regular occurrence while elsewhere the attacks are sporadic. Occasional items in apicultural literature indicate that the habit is not restricted to this state. The first instance (in 1929), over a period of ten years, where severe damage resulted in the apiary of the University of California at Davis has served to supply certain details of this habit.[1]

The University apiary (of about 70 hives in 1929) is located adjacent to an old creek channel lined with cottonwoods and willows. Striped skunks are common along the creek bed and in the adjacent agricultural areas at all seasons of the year.

The first indications of marauders in the apiary consisted of scratches on the earth in front of the hives and on the fronts of the hive boxes. At first, a number of the hives showed these signs; later the work was restricted to about six of them. It was found that if a person tapped or scratched on many of the hives, the bees within exhibited little concern, but such disturbance at hives showing evidence of repeated visits would bring out the tenants in numbers, even after the colonies had been reduced. The marauders seemingly returned to those colonies where their scratchings previously had produced best results—from spirited bees.

The depredations continued, and the nightly scratchings in the earth fronting the hives gradually produced holes, some as much as 6 inches in depth. All bees were cleaned up in front of the hives, including any which might have died naturally in the colonies and have been carried out by their companions during the daytime. When the causative agent was recognized steel traps were set beside the hives showing most evidence of molestation and four fully grown California striped skunks (*Mephitis occidentalis occidentalis*) were captured. The damage was then largely abated but did not cease entirely until the rainy season began.

All four of the trapped skunks had numerous bee stings embedded in the mucous membrane of the tongue, palate and gums. The stings in the mouth may have been pushed out from bees actually crushed when eaten, since this mechanism will operate reflexly in dead bees. A total of 65 stings was counted in the mouth and throat of one of the specimens. We did not actually see the skunks at work, but other observers who have watched skunks attacking hive bees state that following the scratching on the hives the bees rush out whereupon the skunk beats them with its forepaws and then eats them.

The stomachs of two of the skunks were crammed with bees. One of these,

[1] Vansell, G. H., and T. I. Storer, American Bee Journal, vol. 70, 1930, p. 339, 2 figs.

collected November 15, 1929, was well filled, containing 10 per cent of vegetable material (pulp and skins, apparently a fruit), while the animal matter consisted of fragments of at least 145 honey bees (*Apis mellifica*), 87 percent; two lepidopterous larvae, 1 per cent; hair and toe nails of a *Mephitis*, 2 percent; and two nematodes (details as determined by Food Habits Research Laboratory, U. S. Bureau of Biological Survey, Denver, through the kindness of E. R. Kalmbach). The intestine of this skunk contained additional remains of bees. Skunk droppings seen adjacent to the hives were composed largely of the remains of bees; one such dropping contained remains of 108 hive bees, a field cricket (*Gryllus assimilis*), a Jerusalem cricket (*Stenopelmatus longispina*), and remains of raisins. All of the evidence indicated that these individual skunks were subsisting chiefly upon bees, and this conclusion was borne out by the condition of the six "spirited" colonies, which became so reduced in population that they had to be combined with other colonies in order to survive the winter.

In explanation of this attack we noted that the autumn of 1929 was dry; no rain fell until December 9. Attacks on the hives began about mid-October and continued until the rains broke. Through this period the ground generally was dry and hard. Populations of insects such as would ordinarily have provided food for skunks had diminished with the advent of cooler weather. It seems possible that the skunks had turned to the hive bees because of difficulty in digging for their food, as usual, in the fields.

Dr. J. E. Eckert, now in charge of the University apiary, has recently reported (Gleanings in Bee Culture, vol. 60, 1932, pp. 559–560) that a skunk trapped beside one of the hives had 33 stings about the head and others elsewhere on the body, besides numerous additional stings in the mouth, tongue, throat, and stomach. None was present in the oesophagus which led him to conclude that those found in the wall of the stomach probably resulted from reflex operation of the stings. Plath (American Naturalist, vol. 57, 1923, pp. 570–574) has recorded the habits of a captive *Mephitis* in feeding upon bumble bees.

Apiculturists in certain localities suffer damage by skunks almost every year. The trouble is not restricted to bee yards surrounded by wild land, but may occur in apiaries located in closely cultivated areas.

Beekeepers ordinarily control skunks by poisoning, using bee brood or chicken eggs poisoned with strychnine. Trapping is also practiced. The skunks which we captured were taken in an unbaited, exposed steel trap placed in a scratched hole adjacent to one of the hives. The trap chain was fastened to the end of a 12-foot scantling. Each skunk, as captured, was led gently (the operator being on the other end of the scantling) to a nearby garbage can filled with water and drowned without any unpleasant consequences. Other bee keepers have since adopted this method with satisfactory results.

For apiaries where damage by skunks is of more or less regular occurrence we believe that adequate fencing is the proper solution for the difficulty. Skunks are able to and do, at times, climb fences of wire mesh. One apiary surrounded by a 4-foot fence of poultry wire is reported to have been entered by skunks. The type of fence used around muskrat enclosures should prove successful against skunks, although the netting may be of larger mesh and of lighter wire. We submit as minimum requirements the following (see fig. 1): poultry netting of mesh not greater than two inches, and 36 to 48 inches in

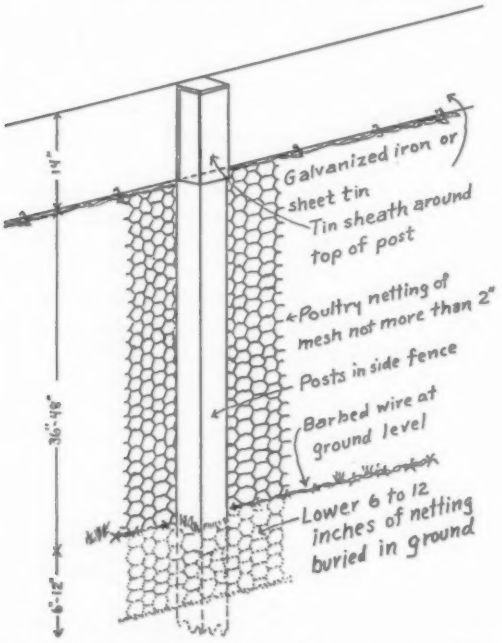

FIG. 1. FENCE TO SURROUND APIARY AS A PROTECTION AGAINST SKUNKS

height, with an additional 6 to 12 inches of wire buried in the ground; a barbed wire along the base of the fence; and the top of the netting surmounted by a continuous strip of galvanized iron or sheet tin 14 inches in width, joined to the top of the netting with "hog rings" at intervals of about 2 feet.

Posts should be on the inside of the fence, and, as an added precaution, should be cased around with tin at the level of the metal strip. The gate giving entrance to such an enclosure should be substantial and close-fitting, sheathed with metal at the top, and abutting against a sill at the bottom to prevent skunks from burrowing beneath.

We are not concerned here with the general food habits of skunks, which in the main are beneficial, or with the importance of skunks in the fur supply. The use of fencing to exclude skunks from apiaries will be of benefit to beekeepers and also aid in the conservation of skunks.

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THE CRANIAL FORAMINA IN RODENTS

By John Eric Hill

A good description was given by Turner (1848) of certain foramina in the base of the cranium in the rat, in which animal this author dissected the contents of these openings. Unfortunately the rat is not typical in these respects for rodents, as Turner seemingly thought. Flower (1876), in his work on the osteology of mammals, apparently based his description of the foramina in rodents on Turner's paper. Cope (1880), in describing and naming the vascular foramina in the squamosal bone of mammals, included several rodents. Van Kampen (1905) discussed exhaustively the foramina and canals of the tympanic region in mammals. Howell (1924) in describing the skull of the meadow mouse (*Microtus*) included a description of the foramina; and more recently (1932) this author has given a more complete account of the foramina in the skulls of the kangaroo rat (*Dipodomys*) and of two jerboas (*Allactaga* and *Scirtopoda*). However, several of the foramina in the skulls of rodents have not been described, at least not satisfactorily, having been homologized with those in other mammals without considering the nerves and blood vessels which they transmit.

In the work here reported upon, the cranial foramina were dissected in the following rodents: mountain beaver (*Aplodontia rufa*), two species of squirrel (*Sciurus griseus, Citellus richardsonii*), three species of pocket gopher (*Thomomys bottae, T. bulbivorus, Geomys bursarius*), wood rat (*Neotoma fuscipes*), and laboratory rat (*Rattus norvegicus*).

Cleaned skulls of each of the above species were examined and, in addition, skulls of the following forms: beaver (*Castor canadensis*), two species of squirrel (*Sciurus douglasii, Citellus beecheyi*), two species of pocket mouse (*Perognathus spinatus, P. fallax*), two species of kangaroo rat (*Dipodomys spectabilis, D. deserti*), kangaroo mouse (*Microdipodops megacephalus*), pocket gopher (*Cratogeomys castanops*), deer mouse (*Peromyscus californicus*), grasshopper mouse (*Onychomys leucogaster*), meadow mouse (*Microtus californicus*), muskrat (*Ondatra zibethica*), jumping mouse (*Zapus princeps*), and porcupine (*Erethizon epixanthum*).

In the various rodents the cranial foramina are similar enough in position

for one to be fairly certain of their homologies with each other. The grooves for the blood vessels substantiate the identifications in cases of foramina and canals transmitting these structures.

The name interpremaxillary foramen (fig. 1) is here proposed for a small foramen between the premaxillary bones, situated immediately posterior to the incisors. It is relatively large in *Aplodontia*, but is minute in the other rodents examined and may be absent in individuals. It transmits a branch of the palatine artery which supplies the anterior part of the nasal cavity.

The incisive (anterior palatine) foramina are extensive in the muroid rodents, in the jumping mouse, and in the porcupine; they are small in the other forms. The former condition is probably the more primitive. These

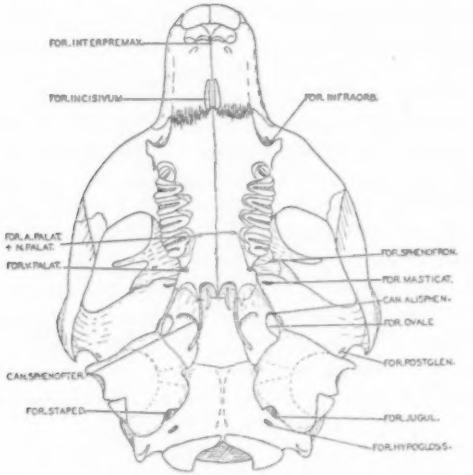

FIG. 1. BASAL VIEW OF CRANIUM, CITELLUS RICHARDSONII, × 1½

openings contain the nasal branches of the palatine arteries and the naso-palatine ducts of the organ of Jacobson.

The condition of the infraorbital foramen and the relation of the masseter muscle thereto have been used in recent years as criteria for the classification of rodents (Tullberg, 1899; Miller and Gidley, 1918). The condition of this foramen in *Aplodontia* is probably the most primitive among living rodents: the foramen is relatively large but transmits no part of the masseter muscle. In the squirrels and in *Castor* the infraorbital foramen is reduced in size; it transmits no muscle fibers, and it is lengthened to form a canal. In the pocket gophers and their allies (*Perognathus*, *Microdipodops*, and *Dipodomys*) the canal is increased in length and is buried in the side of the rostrum. In

the muroid rodents and in the porcupine the infraorbital foramen is enlarged, and it is invaded by the medial masseter muscle. In the jumping mouse (*Zapus*) the foramen for the infraorbital nerve is small, while dorsal to it is a large fenestrum for the medial masseter muscle (cf. Howell, 1932). The thin plate of bone separating the two openings is not fused with the orbital process of the maxillary and leaves, in some specimens, a small fissure connecting the openings. From the appearance of these structures it would seem that in *Zapus* the small infraorbital foramen is a secondary development and that in phylogenetic history it had been continuous with the opening for the medial masseter muscle, as in the muroids and in the porcupine. The infraorbital foramen, in all forms, transmits the infraorbital nerve and the infraorbital blood vessels.

In the rodents examined, with the exception of the muroid forms and *Zapus*, the nasolacrimal canal (figs. 2, 3) begins in the dorsal anteromedial angle of the orbit. The lacrimal bone forms parts of the medial and posterior

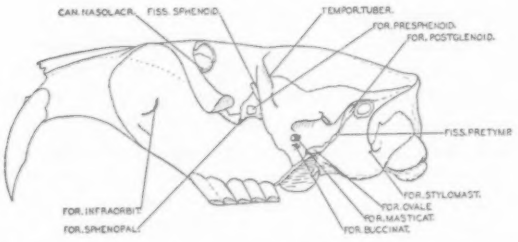

FIG. 2. LATERAL VIEW OF CRANIUM, THOMOMYS BOTTAE, × 1½, ZYGOMA PARTLY REMOVED

walls of the first part of the canal, and in the porcupine the bone entirely surrounds the canal. The second part of the nasolacrimal canal is enclosed by the maxillary bone. In most rodents the canal runs anteriorly, curves around the alveolus of the incisor tooth and enters the nasal cavity. In the porcupine, however, it runs posteriorly for a short distance and passes medial to the incisor. In the muroid forms and in *Zapus* the proximal opening of the canal is on the rostrum in front of the zygoma, the first part of the canal being absent.

The anterior ethmoid foramen is usually present in the frontal bone, anterodorsal to the optic foramen. In *Geomys* and *Cratogeomys*, and in certain species of *Thomomys* (*bottae*, *perpallidus*, *bulbivorus*, and *townsendii*) it is confluent with the large sphenoidal fissure. In other species of *Thomomys* (*douglasii*, *fossor*, *fuscus*, *monticola*, *quadratus*, *talpoides*, and others) the foramen is distinct. It permits the passage of the anterior ethmoid nerve, a branch of the ophthalmic, into the cranial cavity; the nerve runs thence to the nasal cavity through the cribriform plate of the ethmoid.

The sphenopalatine foramen (fig. 2) is large in most rodents; it is situated between the orbital process of the maxillary and the orbital process of the palatine bone, in the ventral medial wall of the orbit. In the pocket gophers it is partly bounded by the presphenoid. This foramen transmits the sphenopalatine nerve, a branch of the maxillary, and the sphenopalatine blood vessels.

The presphenoid foramen (fig. 2) is present only in pocket gophers (it is double in *Geomys bursarius*). It is a large opening in the presphenoid, transmitting a sinusoid vein between the orbits.

The optic nerve passes into the cranium through the optic foramen (fig. 3) in the orbitosphenoid. In the pocket gophers the foramen is separated from the sphenoidal fissure in most specimens by a narrow bar; this may, however, be absent (frequently so in *Geomys bursarius*: Merriam, 1895). In the pocket mice, the kangaroo rats, the kangaroo mouse, and the jumping mouse the optic foramen is similarly bounded by a narrow bar; but in the other rodents examined the orbitosphenoid elements are larger, and they separate the optic foramen widely from the sphenoidal fissure.

The sphenoidal fissure (figs. 2, 3) in rodents corresponds to the superior orbital fissure and the foramen rotundum of primates, and it is also the anterior opening of the alisphenoid and sphenopterygoid canals. The fissure is situated between the orbito- and alisphenoid elements, its ventral margin formed by the maxillary. The sphenoidal fissure permits the passage of the oculomotor, trochlear, abducent, ophthalmic, and maxillary nerves, the internal maxillary artery and, usually, the internal maxillary vein. In the pocket gophers this vein does not pass through the foramen, probably having been displaced by the internal pterygoid muscle; in some muroid forms the vein is absent. The "foramen rotundum" of Merriam (1895) is not homologous with that opening in other mammals, and is described below as the buccinator foramen. The "foramen rotundum" of Howell (1924), described in *Microtus*, is doubtless homologous with the alisphenoid foramen which, in *Rattus*, permits the internal maxillary artery to pass into the cranium.

The canal for the palatine artery and palatine nerve (fig. 1) runs ventrad between the roots of the second and third molar teeth. It opens on the palate near, or on, the suture between the palatine and maxillary bones. In the porcupine there is a larger canal, apparently for a blood vessel, in the maxillary bone and opening in the nasal cavity, and the canal described above is small. In the pocket gophers, the canal for the palatine vein branches from the arterial canal and opens in the palatine pit. This canal is separate from the arterial canal in most rodents; it is absent in *Zapus* and in *Rattus*.

Howell (1932) gave the name squamosal foramen to an opening situated in the squamosal bone, dorsomedial to the root of the zygoma. It transmits a vein from the orbit which empties into the postglenoid vein. This foramen was observed by me only in *Dipodomys* and *Microdipodops*.

The name sphenofrontal foramen (fig. 1) is here proposed for a small opening situated where the frontal, orbitosphenoid, and alisphenoid bones meet. It transmits a branch of the stapedial artery into the orbit. The sphenofrontal foramen was found only in *Citellus*, *Sciurus*, *Neotoma*, and *Zapus*. There is, however, a fenestrum in the same position in pocket mice, kangaroo rats, and kangaroo mice, which seems not to be concerned with the transmission of blood vessels.

The name masticatory foramen (figs. 1, 2) is proposed for the opening called by Merriam (1895) and Howell (1932) "foramen ovale," but which is not homologous with the foramen ovale in other mammals, since it transmits only the masticatory branch of the mandibular nerve and not the nerve itself. It pierces the lateral wall of the alisphenoid canal ventral to the mandibular fossa

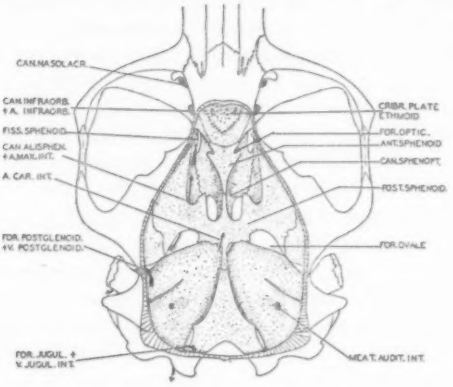

FIG. 3. ENDOCRANIAL VIEW, THOMOMYS BOTTAE, × 1½
Arrows represent blood vessels

and caudal to the sphenoidal fissure. The masticatory foramen is frequently confluent with the buccinator. The former transmits the deep temporal artery, a branch of the internal maxillary, in addition to the masticatory nerve. The foramen is present in all the rodents examined by me with the exception of *Rattus*, *Microtus*, and *Ondatra*, in which genera its absence is due to the reduction of the alisphenoid canal.

The buccinator foramen (fig. 2) is, in most rodents, confluent with the preceding. When distinct, as it is in individuals of *Citellus* and in most pocket gophers except *Thomomys bulbivorus*, it is small and round, situated ventral to the masticatory foramen. It transmits the buccinator nerve, a branch of the masticatory.

In rodents the alisphenoid canal (figs. 1, 3) usually transmits the masticatory nerve in addition to the internal maxillary artery; but in *Rattus*, *Microtus*,

and *Ondatra* the canal is reduced to a groove and a foramen for the artery and the nerve is not inclosed in the alisphenoid. In *Erethizon* the masticatory nerve lies in a separate canal, the external alisphenoid canal (Turner, 1848), and the large alisphenoid canal is invaded by the internal pterygoid muscle. In *Castor* there is a large single canal in the alisphenoid bone which transmits the nerve and, apparently, the internal maxillary artery and vein. In *Aplodontia* and *Citellus* the alisphenoid canal is small, buried in the root of the lateral pterygoid plate; it contains the nerve and artery. A larger, medial sphenopterygoid canal for the internal maxillary vein is present. The two canals unite near the level of the masticatory foramen and open into the orbit by the sphenoidal fissure. In *Sciurus* the roof of the alisphenoid canal is incomplete for a short distance, while in the pocket gophers and their allies, and in the muroid forms, the roof is absent except for a short posterior portion. The alisphenoid canal in these rodents contains only the nerve and artery. In *Zapus* the canal is represented merely by a groove on the floor of the cranium.

The sphenopterygoid canal or foramen (figs. 1, 3) opens caudally in, or near, the pterygoid fossa; it is not distinct from the alisphenoid canal in *Erethizon* and *Castor*, and it is absent or vestigial in the muroid forms. When present, the canal usually transmits the internal maxillary vein, but in the pocket gophers it is occupied instead by the internal pterygoid muscle. In *Aplodontia* the sphenopterygoid canal is large, and it is only slightly smaller in the squirrels. In *Perognathus*, *Dipodomys*, and *Microdipodops* it is reduced to a foramen for a large vein (cf. Howell, 1932, "pterygoid foramen"). The sphenopterygoid canal has been usually identified as the alisphenoid canal, but the latter name was originally given to the canal for the internal maxillary artery.

A vascular canal is present in the basisphenoid bone near the level of the foramen ovale, which contains a vein connecting the two internal maxillary veins. The canal is large in the squirrels, in *Aplodontia*, in most muroid forms, and in *Zapus*; it is vestigial in pocket gophers and their allies (*Perognathus*, *Dipodomys*, *Microdipodops*); and it is absent in *Erethizon*.

The foramen ovale (figs. 1, 2, 3), through which the mandibular nerve leaves the cranium, is confluent with the foramen lacerum in *Castor*, in pocket gophers, *Perognathus*, *Dipodomys*, *Microdipodops*, *Zapus*, and *Erethizon*. When distinct it is situated in the alisphenoid, near the posterior boundary of this element; otherwise it is situated between the alisphenoid and the tympanic bulla. In addition to the nerve, this foramen transmits a small artery, a branch of the internal maxillary. The "foramen ovale" of Merriam (1895) and of Howell (1932) has been described above as the masticatory foramen.

The foramen lacerum (foramen lacerum medium) is absent in the squirrels and in *Aplodontia*, but it is present in the other rodents examined, although reduced in size in the muroid forms. The internal maxillary artery is, in the

muroid rodents, a branch of the stapedial, and it emerges through this opening from the cranial cavity and enters the reduced alisphenoid canal.

The canal for the internal carotid artery may not be homologous with that in man, since in rodents it usually consists merely of a groove on the medial wall of the tympanic bulla, and its medial wall is formed by the basioccipital and basisphenoid bones. It is present in *Castor*, *Sciurus*, the muroid forms, and *Zapus*. In *Perognathus*, *Dipodomys*, and *Microdipodops* the canal is not separable from the elongate jugular foramen, while in the pocket gophers and in *Erethizon* the carotid artery enters the cranium by a small opening between the basisphenoid and petrotympanic bones at the anterior end of the tympanic bulla (fig. 3).

The opening for the stapedial artery (fig. 1) is present in most rodents, but not in the pocket gophers nor in *Aplodontia*. In the pocket gophers, however, there is frequently a depression on the bulla marking the remains of the foramen. This depression is situated near the caudomedial angle of the bulla, near the union of the tympanic with the mastoid, where the foramen is located in other rodents. The canal passes through the stapes and emerges in the cranial cavity between the petrosal and tympanic bones.

The postglenoid foramen (figs. 1, 2, 3) is present in most rodents, but is absent in the porcupine. In its typical condition it transmits a large vein which drains most of the cranial cavity, including the brain. In animals in which this vessel is well developed the internal jugular vein is vestigial or absent. In the pocket gophers and their allies, in the muroid rodents, and in *Zapus*, the postglenoid foramen is usually confluent with the fissure in front of the tympanic bulla. In *Sciurus*, *Citellus*, and *Castor* this foramen is situated in the squamosal bone, and in these genera it is smaller than in the others.

The subsquamosal foramen, as defined by Cope (1880), pierces the posterior part of the squamosal bone below the crest which joins the posterior root of the zygoma with the inion. It is a large foramen in *Citellus*, in most muroid forms, and in *Zapus*, but it is smaller in *Sciurus*. It is absent in the pocket gophers and their allies, in *Erethizon*, and in *Rattus*. The subsquamosal foramen in *Castor* and in *Neotoma* is bounded posteriorly by the mastoid, but in the other rodents in which it is present it is inclosed in the squamosal. This condition appears to be secondary. In *Citellus* the subsquamosal foramen transmits a vein which drains the brain, and in this genus the postglenoid vein is small and empties into the transverse sinus, collecting blood from the region of the mandibular fossa. In *Neotoma*, however, the subsquamosal foramen was found to transmit no vessel. The postsquamosal foramen of Cope (1880) appears to be homologous with the subsquamosal, at least in rodents. Howell (1924) calls this opening in *Microtus* "prelambdoidal fenestrum."

Of the forms examined, the suprasquamosal foramen was found only in *Zapus*. In this rodent it pierces the squamosal bone dorsal to the crest joining the inion and the zygoma.

Several temporal foramina are present in those rodents in which the temporal muscle is large, for example, in *Castor*, *Aplodontia*, *Thomomys bulbivorus*, and *Erethizon*. These openings are situated along the suture between the squamosal and parietal bones, or in the parietal; they transmit veins which drain the deep part of the temporal muscle and which empty into the transverse sinus in the cranial cavity.

The mastoid foramen is present in *Zapus*, in *Castor*, and in *Citellus beecheyi*; it is a small opening between the mastoid and occipital bones, at the dorsomedial angle of the former. The mastoid foramen transmits a small vein which empties into the transverse sinus and which apparently drains the deep muscles of the neck.

The stylomastoid foramen (fig. 2), permitting the egress of the facial nerve, is situated mediocranial to the mastoid process, near the line marking the division between the mastoid and tympanic elements. The stylomastoid foramen varies in the several rodents examined, but unimportantly.

The jugular (posterior lacerate) foramen (figs. 1, 3) is situated between the tympanic bulla and the basioccipital. In most rodents it is small, since the internal jugular vein is vestigial, but in *Perognathus*, *Dipodomys*, and *Microdipodops* it is large and slit-like. In addition to the internal jugular vein, the foramen transmits the ninth, tenth, and eleventh nerves.

In *Aplodontia*, *Castor*, and *Erethizon*, the hypoglossal (condyloid) foramen (fig. 1) is a large opening at the anterolateral side of the occipital condyle. In the other rodents examined there is here a depression, at the bottom of which several foramina open. The hypoglossal nerve emerges from the cranial cavity through the hypoglossal foramen or foramina.

LITERATURE CITED

Cope, E. D. 1880. On the foramina perforating the posterior part of the squamosal bone of the Mammalia. Proc. Amer. Philos. Soc., vol. 18, pp. 452–461, figs. 6.

Flower, W. H. 1876. An introduction to the osteology of the Mammalia. London: The Macmillan Company, Limited; pp. i–xi, 1–344, figs. 126.

Howell, A. B. 1924. Individual and age variation in *Microtus montanus yosemite*. Journ. Agric. Research, vol. 28, pp. 977–1015, pl. 1, figs. 25.

——— 1932. The saltatorial rodent *Dipodomys*: the functional and comparative anatomy of its muscular and osseous systems. Proc. Amer. Acad. Art. Sci., vol. 67, pp. 377–536, figs. 28.

Kampen, P. N. van. 1905. Die Tympanalgegend des Säugetierschädels. Morph. Jahrb., vol. 34, pp. 321–722, figs. 96.

Merriam, C. H. 1895. Monographic revision of the pocket gophers, family Geomyidae. North Amer. Fauna, No. 8, pp. 1–213, figs. 71, pls. 19, maps 3.

Miller, G. S., and J. W. Gidley. 1918. Synopsis of the supergeneric groups of rodents. Journ. Washington Acad. Sci., vol. 8, pp. 431–448.

Tullberg, T. 1899. Über das System der Nagethiere, eine phylogenetische Studie. Nova Acta Reg. Soc. Sci. Upsala, ser. 3, vol. 18, Sec. Med. Hist. Nat., pp. 1–514, pls. 57.

TURNER, H. N., JR. 1848. Observations relating to some of the foramina at the base of the skull in Mammalia, and on the classification of the order Carnivora. Proc. Zool. Soc. London, 1848, pp. 63–68.

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SOME BREEDING NOTES ON RODENTS

BY SHALER E. ALDOUS

While engaged in field work for the United States Biological Survey between the years 1929 and 1931, I had the opportunity of making pregnancy studies of various rodents. To make the findings from these examinations available to other investigators, it seems desirable to present a brief summary of the essential data.

TABLE I

UTERUS RIGHT HORN	UTERUS LEFT HORN	TOTAL	LENGTH OF EMBRYO IN MILLIMETERS
3	2	5	25
0	4	4	30
4	3	7	20
4	2	6	35
2	2	4	35
5	1	6	25
4	2	6	35
3	1	4	25
4	0	4	20
3	1	4	15
2	4	6	25
3	3	6	30
1	3	4	25
3	2	5	5
3	3	6	25
2	2	4	15
2	1	3	20
3	3	6	20
0	1	1	20
3	2	5	30
1	4	5	25
1	3	4	30
2	4	6	25
2	3	5	40
3	2	5	20
2	2	4	30
3	1	4	25
Total.....68	61	129	
Average.... 2.52	2.26	4.78 per litter	

Cynomys gunnisoni zuniensis

Two specimens taken at about 7,000 feet altitude near Flagstaff, Arizona, on May 8 and 11, 1929, had 4 and 3 uterine scars respectively, and both were nursing young.

Fourteen females were examined at Redvale, Colorado (approximately 6,500 feet altitude) on April 15, 1931. One of these contained 4 embryos, each 31 mm. in length, 2 in each horn of the uterus. As the other thirteen were nursing young, no scar counts were made.

Twenty-nine females were examined at Norwood, Colorado (7,000 feet altitude) on April 17, 1931, all but two of these were pregnant. Of these two, the uterus of one was normal and of the other diseased. Table I gives the number of embryos, and their size.

One female examined on Dolores Pass, Colorado (approximately 10,000 feet altitude) on May 9, 1931, had 3 embryos about ready for birth.

TABLE II

LOCALITY	DATE	NUMBER EXAMINED	BREEDING CONDITION
Hatch, N. M.	Feb. 22, 1929	3	Normal uteri
		4	Uterus swollen and congested
		1	4–10 mm. embryos
	Feb. 23, 1929	13	Normal uteri
		2	Uterus swollen and congested
		3	4 scars in uterus
		1	2 scars (both in same horn)
		1	4–19 mm. embryos
	March 6, 1929	40	Normal uteri
		4	Uteri swollen
		9	Uteri swollen and congested
		9	Uterine scars, varying 3 to 6
		1	3–10 mm. embryos
		1	2–20 mm. embryos
		1	7–8 mm. embryos
		1	4–30 mm. embryos
		1	1–8 mm. embryo and 1 old scar
		1	4–6 mm. embryos

These 1931 records indicate the period of birth around Norwood, Colorado, to be from about April 15 to 25, and that the time of birth was delayed about ten days by a thousand foot increase in altitude. These figures would not necessarily hold true for every year owing to variations in weather and vegetation.

Thomomys fulvus toltecus

While working with the pocket-gopher-control crew operating in the lower Rio Grande River Valley, New Mexico, during February and March, 1929, I had opportunity to examine a number of pocket gophers for breeding data. Table II shows the findings.

The 68 females examined on March 6, 1929, were from a lot of 110, the remainder including 27 males and 15 half-grown young. The number of young per uterus varied from 1 to 7, with an average of 3.8. The results shown in the table, together with the

fact that young pocket gophers of various sizes were caught in traps during the whole period of October to April, indicate that the breeding period of the animal in the lower Rio Grande Valley extends over much of the entire year.

Dipodomys ordii ordii

One female examined October 20, 1929, on the Jornada Range Reserve, New Mexico, showed 2 embryos, 17 mm. long, both in the left horn. On October 25, 1929, at the same locality, one female showed one embryo 30 mm. long in the left horn of the uterus. One female examined January 27, 1929, at Wilcox, Arizona, had one embryo, 6 mm. long, in each horn of the uterus.

Callospermophilus lateralis arizonensis

One female examined May 7, 1929, at Flagstaff, Arizona, contained 5 embryos 8 mm. long.

Citellus spilosoma major

One female examined April 12, 1929, on the Jornada Range Reserve, New Mexico, revealed 7 embryos, each about 15 mm. long; ten mammae were enlarged.

United States Biological Survey, Denver, Colorado.

DISTRIBUTION OF THE ILLINOIS POCKET GOPHER, GEOMYS BURSARIUS ILLINOENSIS

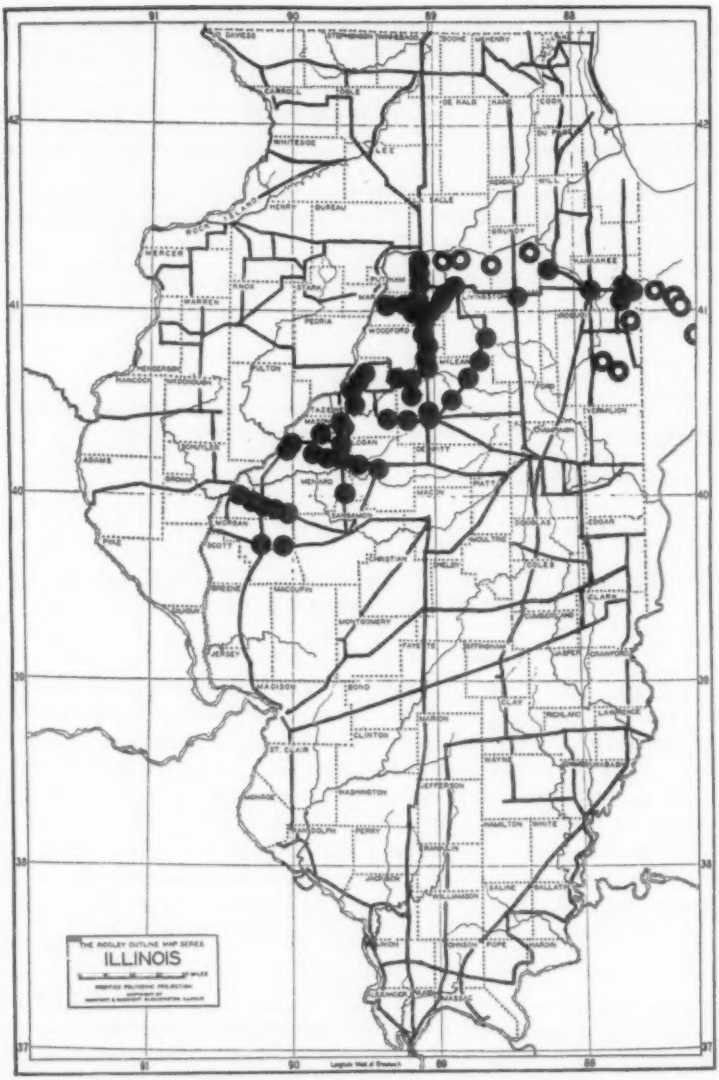
By Carl O. Mohr

While traveling for the Illinois State Natural History Survey during the years 1930–34, the writer has taken advantage of the opportunity to record localities where mounds of the Illinois pocket gopher, *Geomys bursarius illinoensis* Komarek and Spencer, were seen. The set of records here listed, now as nearly complete as it can be made without months of special effort, is plotted on the map along with the highways that were traveled, and well defines the main part of the gopher's present range.

Since the range is now probably changing in detail, if not generally, because of long continued, intensive cultivation and increased road improvement, both of which disturb colonies severely, the records are important.

LOCALITIES

Mounds were seen at localities listed below. County names are in bold face type. **Cass**: Ashland, Beardstown, Bluff Springs, Philadelphia, Virginia; **Kankakee**: Hopkins Park, Kankakee, Momence, St. Anne; **LaSalle**: Lostant, Oglesby, Rutland, Streator, Tonica; **Livingston**: Dwight, Munster, Pontiac. **Logan**: New Holland, Lincoln; **McLean**: Bloomington, Carlock, Chenoa, Normal, Lexington, Stanford, Towanda; **Marshall**: Evans, Garfield, Lacon, Toluca, Wenona, Varna; **Mason**: Easton, San Jose, Havana, Mason City, Manito, Quiver Lake, Teheran; **Menard**: Fancy Prairie; **Morgan**: Alexander, Jacksonville; **Tazewell**: Delavan, Farmingdale, Green Valley, Minier, Mor-



DISTRIBUTION OF THE ILLINOIS POCKET GOPHER

● Localities at which mounds of the gopher were seen by the writer. —— Highways traveled while making the observations. o Localities from which other writers have recorded the gopher in the last ten years.

ton, Pekin, Washington; **Will:** Custer Park; **Woodford:** Congerville, El Paso, Goodfield, Kappa, Minonk, Panola. These township records are represented as black spots on the map.

Komarek and Spencer (1931) recorded some of these localities and the following additional ones. **DeWitt:** Clinton; **Kankakee:** Beaverville; **LaSalle:** portions of LaSalle, Ottawa and Utica lying south of the Illinois river; **Champaign.** From Indiana they recorded Lake Village and Thayer, Newton County. Lyon (1932) added the following Indiana records: **Newton:** Roselawn; **Jasper:** Fair Oaks, Rensselaer; and northwestern **Tippecanoe.** These township records are represented as circles on the map.

Others wrote before 1913 that pocket gophers were found in small numbers at the following localities in Illinois: **Cook** (Merriam 1895); **Jefferson:** Woodlawn (Howell 1910); **Macoupin:** Anderson (Cory 1912); **Marion:** Odin (Howell 1910); **Randolph:** Coulterville (Howell 1910); **Richland:** Olney (Howell 1910); **St. Clair:** Belleville (Merriam 1895).

The records last listed may now be largely a matter of history rather than of present-day distribution, and are therefore not recorded on the map. They are extremely interesting from an ecological point of view, especially since it is recorded that pocket gophers were not abundant at these localities and that the range here was not continuous with the main body, in the sense that the travels of an individual or the expansion of a colony by reproduction was not likely to unite that colony with the main one. It is quite likely that these isolated colonies are "remnants" doomed to extinction. That they are now isolated, if they still exist, seems conclusive by the fact that no mounds were observed along much of the network of roads travelled by the writer while making records.

Champaign and Cook county records are now definitely a matter of history, if they were correct. No writer of recent years has noted mounds or specimens in either county, and Wood (1910) took the trouble to write that none were present in Champaign county at that time. The writer has since traveled widely over that county without seeing traces of them. Sanborn (1925) did not list the gopher from Cook county.

Gophers are abundant, as pointed out by Komarek and Spencer, on brown sandy loam near Havana and St. Anne, but they are by no means confined to that type of soil. By far the larger proportion of their range is restricted within the more extensive brown silt loam area near the center of the state and known as prairie soil. Most of this is less than one per cent sand.

In these areas they are common under prairie cover, which is sub-climax to the eastern deciduous forest formation (Shelford, 1931). Although they are more inclined to work under the thin growths of trees when in the sandy areas, they are indicators of prairie conditions.

BIBLIOGRAPHY

Cory, C. B. 1912. The mammals of Illinois and Wisconsin. Field Mus. Nat. Hist., Pub. 153, vol. 11, pp. 239–245. [*Geomys bursarius* (Shaw).]

Howell, A. H. 1910. Notes on mammals of the middle Mississippi Valley, with description of a new woodrat. Proc. Biol. Soc. Washington, vol. 23, p. 31. [*Geomys bursarius* (Shaw).]

Komarek, E. V. and Don A. Spencer. 1931. A new pocket gopher from Illinois and Indiana. Journ. Mamm., vol. 12, pp. 404–408.

Lyon, M. W., Jr. 1932. Remarks on *Geomys bursarius illinoensis* Komarek and Spencer. Journ. Mamm., vol. 13, pp. 77–78.

Merriam, C. H. 1895. Monographic revision of the pocket gophers. North Amer. Fauna no. 8, pp. 120–127. [*Geomys bursarius* (Shaw).]

SANBORN, C. C. 1925. Mammals of the Chicago area. Field Mus. Nat. Hist., Zool. leaflet 8, pp. 129–151.
SHELFORD, V. E. 1931. Some concepts of bioecology. Ecology, vol. 12, pp. 455–467.
SMITH, R. S. AND and E. A. NORTON. 1928. Provisional soil map of Illinois. Univ. Illinois Agric. Exper. Sta.
VESTAL, A. G. 1931. A preliminary vegetation map of Illinois. Trans. Illinois State Acad. Sci., vol. 23, pp. 204–217.
WOOD, F. E. 1910. A study of the mammals of Champaign County, Illinois. Bull. Illinois State Labor. Nat. Hist., vol. 8, pp. 560–563. [Pocket-gopher.]

Illinois State Natural History Survey, Urbana, Illinois.

NOTE ON THE CLASSIFICATION OF RECENT AND FOSSIL OPOSSUMS

BY GEORGE GAYLORD SIMPSON

The generic name of the common opossum, type of its group, was spelled *Didelphis* by Linnaeus, 1758. This is considered erroneous etymologically, but there is no clear evidence that it was a typographical error and under the Rules this spelling should stand. The transliteration *Didelphys* was first used by Schreber, 1777. The family of which this genus is typical was first named Didelphidæ Gray, 1821. Subsequent emendations include Didelphydæ Baird, 1857, Didelphididæ Gill, 1872, Didelphyidæ Forbes, 1881, and Didelphiidæ Miller and Rehn, 1901. The correct form of the family name depends on whether the root of the generic name is taken as *Didelph-*, *Didelphi-*, *Didelphid-*, or *Didelphy-*.

As to the form of a family name, the Rules provide only that they are formed by adding -idæ to the root of the name of the type genus. The determination of the root, or stem, may follow the ordinary rules of Latin grammar, or, what is not invariably the same thing, the usage formulated in the British Association Report for 1842 according to which the root is the [Latin] genitive with its last syllable omitted. In a case, such as that of *Didelphis*, where the name is not, in fact, Latin, presumably any Latin model of identical ending may be used. Here the available models are typified by *lapis*, genitive *lapidis*, stem *lapid-*; *hostis*, genitive *hostis*, stem *hosti-*; or *canis*, genitive *canis*, stem *can-*. The spellings Didelphididæ Gill, 1872, Didelphiidæ Miller and Rehn, 1901, and Didelphidæ Gray, 1821, are apparently based on these three possibilities respectively. I see no reason why Gray's spelling may not be adopted: it is as correct as any other, is shorter and easier to pronounce, and has priority. The forms used by Baird and by Forbes are not available under the Rules.

The opossums are a remarkably conservative group, and the variation in all the known forms, Cretaceous to Recent, is less than in most mammalian families. Any other procedure than to refer all to a single family would be

unjustified on present knowledge. The proposed families Peratheridæ Baird, 1857, Microbiotheridæ Ameghino, 1887, Stagodontidæ Marsh, 1889, Cimolestidæ Marsh, 1889, Thlæodontidæ Cope, 1892, and Chironectidæ [Anonymous], 1897, are therefore considered as included in the Didelphidæ.

The various major groups within the family are conveniently treated as subfamilies. *Chironectes*, despite its aberrant habits, is structurally very close to *Didelphis* and subfamily separation is not warranted. The *Marmosa* line, with its probable offshoots *Philander*, *Monodelphis*, *Dromiciops*, etc., is more varied and divergent, but still hardly warrants separation from the typical subfamily in a broad and conservative view of the group. If these were fossil forms, it is doubtful whether the paleontologist would be justified in placing them in more than one genus.

Among fossil forms, *Peratherium* of the early Tertiary of North America and Europe, with its several synonyms, is very like *Didelphis*, differing consistently in little more than the proportions of the premolars. Peratheridæ Baird, 1857, and Herpetotherinæ[1] Trouessart, 1879, are therefore included in the Didelphinæ. The microbiotheres of the Lower and Middle Tertiary of Argentina, however, while also close to the didelphines, do have somewhat more marked, consistent, and readily recognizable distinctions which may tentatively be recognized as of subfamily value. This was signalized by Ameghino, who proposed the family name Microbiotheridæ Ameghino, 1887, here retained in the subfamily form Microbiotheriinæ Simpson, 1929.[2]

The numerous Cretaceous didelphids of North America show much wider variations than any of those hitherto mentioned. They are too poorly known for definite classification, and some may even warrant family separation, but at present it is more practical to place them in two groups defined as subfamilies. One group, less aberrant and closer to the modern opossums, I have named Pediomyinæ Simpson, 1927. A second group is more specialized, with durophagous characters and other peculiarities in the dentition, and has been variously named Stagodontidæ Marsh, 1889, Thlæodontidæ Cope, 1892, Didelphodontinæ Simpson, 1927, and Thlæodontinæ Hay, 1930.

Stagodon is based on isolated premolars which are at present, and perhaps permanently, unrecognizable as to genus, although perhaps all pertaining to a natural group. The genus, as such, is practically indeterminate, and it seems inadvisable and unnecessary to use a subfamily name with such a poor and uncertain basis. I have also abandoned (1930 and subsequently) my name Didelphodontinæ Simpson, 1927, which is bad on two counts: it is preoccupied by Didelphodontinæ Matthew, 1918,[3] and it is antedated (so far

[1] *Herpetotherium* Cope, 1873, is a synonym of *Peratherium* Aymard, 1850.

[2] It is possible to find classic and recent authority for considering the stem of names in *-therium* as ending in *-ther-* but it seems better to retain the "i" consistently.

[3] Didelphodontinæ Simpson is based on the marsupial, *Didelphodon*, and Didelphodontinæ Matthew on the insectivore *Didelphodus*, but the subfamily names are absolute homonyms.

as recognition of the group, the essential factor, goes) by Thlæodontidæ Cope, 1892. The latter name is therefore retained in the form Thlæodontinæ Hay 1930.

Another supposed group of Cretaceous opossums, sometimes still retained as separate from those just discussed, is Cimolestidæ Marsh, 1889, or Cimolestinæ Trouessart, 1905. *Cimolestes* is another genus now very unsatisfactory. It is based on lower molars, which do not show the diagnostic characters of the subfamilies recognized and cannot at present be surely associated with parts that do. Cimolestinæ is a synonym probably of Pediomyinæ, perhaps of Thlæodontinæ (both of which it antedates); or possibly it includes both. The name therefore is not accurately usable at present, and must be rejected, even aside from the dubious bearing of strict priority on family names.[4]

The arrangement proposed, with brief dental diagnoses, is as follows (modified from my classification of 1929).

Didelphidæ Gray, 1821

Small polyprotodont marsupials. Dental formula $\frac{5\text{–}?.1.3.4.}{4\text{–}3.1.3.4.}$. Incisors all small. Canines large. Premolars simple, trenchant or bulbous. Lower molars tuberculosectorial, with three trigonid cusps and basined heels with hypoconulid posterointernal, near entoconid. Upper molars trigonal, no true hypocone, external cingulum wide, with various well defined marginal cusps (styles).[5]

Pediomyinæ Simpson, 1927

Premolars trenchant. Upper molars didelphine in contour. Paracone and metacone subequal. Pronounced metastylar spur from posterior cingulum. Five stylar cusps (except on M^4), the second (external to paracone) weak and sometimes nearly absent. The fourth (external to metacone) larger than the third (median). Paraconule definite.

Thlæodontinæ Hay, 1930 (*Thlæodontidæ* Cope, 1892)

Premolars bulbous, crushing. Upper molars with broad, bilobed, nearly symmetrical external shelf. Paracone and metacone subequal. No distinct metastylar spur. Second style large and heavy, others variable.

Microbiotheriinæ Simpson, 1929 (*Microbiotheridæ* Ameghino, 1887)

Premolars trenchant. Metacone somewhat larger than paracone (except in M^4). No distinct metastylar spur. External cingulum moderate, of nearly equal width throughout, styles weak. M_4 reduced and with narrow, nearly unbasined, unicuspid heel unlike that of other subfamilies.

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[4] The retention as by Hay in 1930 of all three subfamilies, Pediomyinæ, Thlæodontinæ, and Cimolestinæ is in any case clearly unwarranted.

[5] I have been unable to formulate a satisfactory strictly dental definition which completely excludes the primitive dasyurids. This emphasizes the possibility that some of the early supposed didelphids, known from teeth only, may be as close to the dasyurids as to the didelphids, or, better, that they belong to the common stock of these two geographic groups.

Didelphinæ, Simpson, 1927[6]

Premolars trenchant. Paracone much reduced (except in M^4). Marked metastylar spur. Second style large, fourth smaller than third. Paraconule reduced or absent.

The American Museum of Natural History, New York, N. Y.

A NEW MUSTELID GENUS FROM THE PLIOCENE OF CALIFORNIA

By E. Raymond Hall

In 1917 Professor Chester Stock made a collection of vertebrate fossils from beds on the south side of San Pablo Bay, California, locally referred to as Pinole Tuff. In the collection was a lower jaw fragment of a mustelid which appeared to belong to an undescribed genus. Together with some related specimens, to be reported upon in a more general account, this specimen has not yet been described. Now, however, that Mr. R. A. Stirton has under way a report on the extinct vertebrate faunas of the San Francisco Bay region and has suggested that the specimen in question be placed on record, a name is here proposed for it and mention made of its diagnostic characters.

Cernictis hesperus gen. et sp. nov.

Type.—No. 22968, Univ. California Mus. Palaeo.; fragment of left mandibular ramus bearing M_1 and P_4; from Pinole Tuff, Middle Pliocene, U. C. Mus. Palaeo. locality no. 2572, in sand and gravel mixed with volcanic ash in north facing bank along Southern Pacific Railroad right-of-way, SE¼ of Sec. 16, T2N R4W, one-fourth mile west of Pinole Junction, Contra Costa County, California; collected February 3, 1917, by Chester Stock.

Diagnosis.—Size (see measurements) slightly greater than in *Plionictis parviloba* Cope; P_4 long with accessory posterior cusp; M_1 short, talonid less than half length of trigonid; basal cingulum extended up anterior border of paraconid, giving appearance of concavity to lateral face of paraconid-protoconid blade; metaconid well developed and connected with tip of protoconid by a distinct ridge; talonid semi-basined; base of metaconid continuous with lingual margin of talonid; base of protoconid separated from buccal margin of talonid by distinct notch; basin of talonid enclosed by ridge apparently without well developed entoconic or hypoconid.

Measurements.—Anterior border of P_4 to posterior border of M_1, 18.9 millimeters; length of P_4, 8.6; breadth of P_4 across heel, 4.2; length of M_1, 11.7; length of trigonid of M_1, measured from notch, 8.6; length of trigonid of M_1, measured from posterior border of protoconid, 7.6; greatest width, over all, of M_1, 5.2; depth of mandible between P_4 and M_1, 12.2.

Relationships and remarks.—In lateral views M_1 of *Cernictis* is suggestive of the Bassariscinae. However, the construction of the talonid, its inclination lingually from the long axis of the trigonid, and other features of this tooth are more nearly as in some undoubted Mustelidae. If *Cernictis*, like *Leptarctus*, approaches the bassariscine-

[6] It seems very probable that this name was used before 1927, and I did not then consider it as new, but I have been unable to find an older reference.

procyonid carnivores, the approaches are along different lines, for even the scanty material available of *Cernictis* shows it to be quite unlike *Leptarctus*.

The continuation of the cingulum up the anterior border of M_1, imparts a scooped-out appearance to the lateral face of the paraconid-protoconid blade that has not been observed in any other small carnivore.

The combination of short M_1, short, semi-basined talonid and large metaconid of M_1, indicates a relatively primitive structural condition. Considering this and the late age, assumedly Middle Pliocene, it is difficult to place *Cernictis* in a position ancestral to any other known form.

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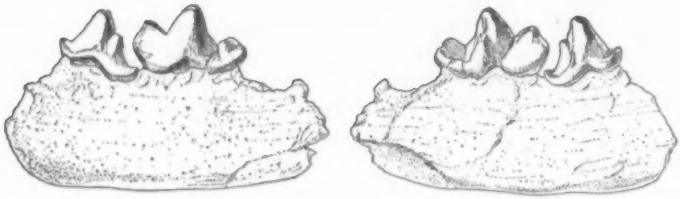

2 3

TYPE SPECIMEN OF CERNICTIS HESPERUS, × 1½

1. Occlusal view. 2. Lateral view. 3. Medial view

Cernictis, then, is thought to be a unique structural type belonging in the family Mustelidae. It is not known to be closely related to any previously named form. If it be found necessary to allocate it to one of the recognized subfamilies it may tentatively be associated with *Martes* and *Gulo* in the Martinae, though in so doing it should be emphasized that *Cernictis* is not closely related to either of the genera mentioned.

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THE STATUS OF REITHRODONTOMYS MONTANUS (BAIRD)

By Seth B. Benson

The status and relationships of *Reithrodontomys montanus* have been uncertain ever since this harvest mouse was named and described by Baird in 1855. Study of the type specimen, and of specimens collected in the type locality of *R. montanus*, has revealed that all the specimens, except the type itself, are examples of the species *Reithrodontomys megalotis* (Baird). Confusion has arisen because these specimens have been mistakenly referred to *R. montanus*.

The nomenclatural history is as follows. Baird (1855, p. 355) described *Reithrodon montanus* on the basis of a single specimen collected by a Mr. Kreutzfeldt [= J. Creutzfeldt, botanist of Gunnison's expedition] at "Rocky Mountains, Lat. 38°." Later, Baird (1857, p. 450) gave the locality as "Rocky Mountains, 39°." Coues (1874, p. 186) listed *Ochetodon montanus* as a questionable species. This he also did later (1877, p. 130), stating "The single specimen is too imperfect to permit of final characterization, or to enable us to come to any positive conclusion; but if the size and coloration it presents are really permanent, we should judge it entitled to recognition as a valid species. At present, however, we regard it with suspicion and are unwilling to endorse its validity."

This remained the status of the name until Allen (1893, p. 80), after examining the type specimen, stated "I have therefore no hesitation in recognizing *Reithrodontomys montanus* (Baird) as a well-marked, valid species, which will probably be found to range from the eastern base of the Rocky Mountains eastward to middle Kansas."

When Allen (1895) revised the harvest mice the type of *montanus* was still unique. In his treatment of the species (pp. 123–125) he determined the type locality to be the upper part of the San Luis Valley in Colorado. He stated that "Until this region has been thoroughly explored for 'topotypes' of *R. montanus*, it would be obviously improper to reject this species as unidentifiable or to give the name precedence over *R. megalotis* for the form here recognized under that name."

At this time the species currently recognized as *albescens* was not known, although Allen actually had specimens which he confused with the form now known as *R. megalotis dychei* (see Howell, 1914, p. 31). Subsequently Cary (1903, p. 53) described *Reithrodontomys albescens* from Nebraska, stating that the species required "no close comparison with any described *Reithrodontomys.*" Bailey (1905, p. 106) described *Reithrodontomys griseus* from Texas, and remarked that it probably graded into *albescens*.

In 1907 Cary visited Medano Springs Ranch in search of topotypes of *R. montanus*. He collected twenty specimens, most of them immature, which he identified as *montanus*. Cary (1911, pp. 108–110), following a manuscript of A. H. Howell, regarded *R. montanus* as a species related to *R. albescens* and *R. griseus*. He placed *albescens* as a subspecies of *montanus*.

When Howell (1914) revised the harvest mice, the specimens from the type locality of *montanus* consisted of the type specimen and the specimens collected by Cary at Medano Springs Ranch. In this revision Howell altered his earlier opinions concerning the relationships of *montanus*. He wrote (p. 26) "The species, although combining in a remarkable degree the characters of the *megalotis* and *albescens* groups, seems not to be directly connected with either of them. It is perhaps best placed in the *megalotis* group, but seems not to intergrade with any member of it." He pointed out that the relationships of the species were yet not clear, since the type specimen did not agree with any of the "topotypes" collected by Cary, but instead resembled specimens of *R. a. griseus* from Texas. Because the color of the "topotypes" agreed with the original description of *montanus*, he decided to "consider the type skull aberrant, and to continue to use the name for the form represented

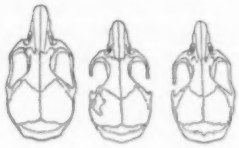

FIG. 1. DRAWINGS MADE FROM PHOTOGRAPHS OF SKULLS OF HARVEST MICE. NATURAL SIZE

a. Reithrodontomys megalotis subsp., no. 61120, Mus. Vert. Zool., from Medano Ranch, 15 miles northeast of Mosca, Alamosa County, Colorado.

b. Reithrodontomys montanus montanus, type specimen, no. 1036/441, U. S. Nat. Mus., from upper end of San Luis Valley, Colorado.

c. Reithrodontomys montanus griseus, no. 58737, Mus. Vert. Zool., from 3 miles north of Socorro, Socorro County, New Mexico.

by the modern series." It might be mentioned here that no specimens of the *albescens* group have as yet been taken near the type locality of *montanus*.

In 1933, Miss Annie M. Alexander and Miss Louise Kellogg collected harvest mice from several localities in Colorado and New Mexico including the type localities of *R. megalotis aztecus* and *R. montanus*. Two of the three specimens from the Medano Ranch, 15 miles northeast of Mosca, Alamosa County, Colorado, were adults similar to adult topotypes of *aztecus*. The third, a young individual, was so much smaller that at first I judged it was of a different species. I suspected then that Howell's treatment of *montanus* was the result of confusing two distinct species, one a small form like *albescens*, the other a larger one like *megalotis*. The occurrence of two species at this locality seemed possible, since *albescens* occurs with *dychei* in Nebraska, *griseus* is known to occur with *dychei* in Kansas, and in 1933 I collected *megalotis* and *griseus* together in the bottom-land of the Rio Grande, three miles

north of Socorro, New Mexico, which is in the same drainage system as San Luis Valley.

At my request the Bureau of Biological Survey loaned me 16 of the specimens collected by Cary at Medano Ranch. Only one of these was fully adult (the one whose skull is figured as *montanus* in Howell's revision). Among the younger specimens were some which matched the smallest of the three specimens collected by Miss Alexander and Miss Kellogg, and the rest formed a series approaching the largest specimens. The adult specimen collected by Cary is smaller than the other two adults, yet is similar to them in most characters. It was obvious that all belonged to a single species. I concluded that all the Medano Ranch specimens I had examined were of the species currently known as *megalotis*. It was also obvious that if the type of *montanus* were conspecific with the other San Luis Valley specimens, *megalotis* would become a synonym of *montanus*, since *montanus* has priority.

Through the courtesy of Dr. Remington Kellogg and others in charge of the collection of mammals in the United States National Museum, I was granted the loan of the type specimens of *R. megalotis* and *R. montanus*. After studying these specimens I reached the following conclusions: (1) The Medano Ranch specimens are conspecific with the type of *megalotis*; (2) the type specimen of *montanus* is specifically distinct from *megalotis*, and is conspecific with *albescens* and *griseus*. Some characters in which the type of *montanus* and specimens of *griseus* (MVZ no. 41192, from Hemphill Co., Texas; no. 56220, from 44 miles northwest of Roswell, N. M.; and no. 58737, from 3 miles north of Socorro, N. M.) differ from *megalotis* are: smaller size; shorter, more depressed rostrum; narrower interorbital space; relatively shorter brain case.

As a result, *megalotis* is not a synonym of *montanus*, and *montanus* becomes the specific name for the species currently known as *albescens*. Until additional specimens of *montanus* from San Luis Valley are available to allow a more thorough appraisal of its characters, it seems best to regard *albescens* and *griseus* as valid races of *montanus*, although it is quite likely that *griseus* may become a synonym of *montanus*. The three races here recognized are:

Reithrodontomys montanus montanus (Baird)
Reithrodontomys montanus albescens Cary
Reithrodontomys montanus griseus Bailey.

It may be well to remark here that all the available information indicates that the species *R. montanus* is rarely abundant and that it prefers more arid, sandier ground than does its relative *R. megalotis*, although both species may be found together.

The racial identity of the San Luis Valley *megalotis* has also presented some problems. At first I referred them to the race *aztecus* because some of them fell within the range of variation present in specimens from within the distributional area assigned to *aztecus* in Howell's revision. In addition, there was so much variation in size in the few adults available to me that I

felt it was possible they did not truly represent the population, and so could not serve as a satisfactory basis for the description of a new race. However, Mr. Howell, who has restudied the problem with the aid of a greater amount of material than was available to me, has concluded that the San Luis Valley *megalotis* represent an unnamed race. He will describe this race in another article.

LITERATURE CITED

ALLEN, J. A. 1893. List of mammals collected by Mr. Charles P. Rowley in the San Juan Region of Colorado, New Mexico and Utah, with descriptions of new species. Bull. Amer. Mus. Nat. Hist., vol. 5, pp. 69–84. April 28, 1893.

——— 1895. On the species of the genus *Reithrodontomys*. Bull. Amer. Mus. Nat. Hist., vol. 7, pp. 107–143. May 21, 1895.

BAILEY, V. 1905. Biological Survey of Texas. U. S. Dept. Agric., North Amer. Fauna no. 25, 222 pp., 16 pls., 24 figs. October 24, 1905.

BAIRD, S. F. 1855. Characteristics of some new species of North American Mammalia, collected chiefly in connection with U. S. Surveys of a Railroad route to the Pacific. Proc. Acad. Nat. Sci. Philadelphia, vol. 7, April, 1855, pp. 333–336.

——— 1857. General report upon the mammals of the several Pacific Railroad routes. U. S. Pac. R. R. Expl. and Surv., vol. 8, pt. 1, xxxiv + 764 pp., 60 pls.

CARY, M. 1903. A new Reithrodontomys from western Nebraska. Proc. Biol. Soc. Washington, vol. 16, pp. 53–54. May 6, 1903.

——— 1911. A biological survey of Colorado. U. S. Dept. Agric., North Amer. Fauna no. 33, 256 pp., 12 pls., 39 figs. August 17, 1911.

COUES, E. 1874. Synopsis of the Muridae of North America. Proc. Acad. Nat. Sci. Philadelphia, 1874, pp. 173–196.

——— 1877. No. I.—Muridae, *in* Coues and Allen, Monog. North Amer. Rodentia (= U. S. Geol. Surv. Terr. [Hayden], vol. 9), pp. 481–542.

HOWELL, A. H. 1914. Revision of the American harvest mice. U. S. Dept. Agric., North Amer. Fauna no. 36, 97 pp., 7 pls., 6 figs. June 5, 1914.

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THE HARVEST MICE OF THE SAN LUIS VALLEY, COLORADO

By Arthur H. Howell

Having been privileged to see Doctor Benson's paper on "The Status of *Reithrodontomys montanus* (Baird)" while in manuscript, I took the opportunity to review this puzzling problem in the light of additional material gathered since my revision of the genus in 1914. Through the kindness of Dr. Joseph Grinnell, of the Museum of Vertebrate Zoology, and Mr. J. D. Figgins, of the Colorado Museum of Natural History, I have been able to assemble 34 specimens of *Reithrodontomys* from the San Luis Valley, Colorado. Most of these are immature, but among them are 11 adults or subadults.

Benson's contention that the type of *R. montanus* is conspecific with *albescens* and *griseus* seems in the light of present knowledge to be correct, and as he points out, *griseus* may prove to be a synonym of *montanus*. This can be proved only if specimens agreeing with the type of *montanus* can be obtained in the vicinity of the type locality. Thus far, all specimens obtained by several different collectors in the San Luis Valley have shown pronounced differences from *montanus*. If the type actually came from that valley, the species must be very local or else have been exterminated there since 1853.

The modern series from the San Luis Valley, as pointed out by Benson, and previously by the writer (North Amer. Fauna, no. 36, p. 26, 1914), shows close relationship with *R. megalotis megalotis*; careful measurements of a series of adults, however, indicate constant differences of sufficient importance to warrant naming of the form. It may be known as

Reithrodontomys megalotis caryi,[1] subsp. nov.

Type.—Female adult, skin and skull, No. 150714, U. S. National Museum (Biological Survey collection); collected at Medano Ranch, 15 miles northeast of Mosca, Alamosa County, Colorado, November 4, 1907, by Merritt Cary; original number 1232.

Subspecific characters.—Similar to *R. megalotis megalotis*, but tail shorter and ear smaller; dorsal surface slightly paler and more grayish (less tawny); sides paler buff.

Description of type.—Upper parts light drab, shaded with fuscous, the hinder back washed with pinkish buff; sides of head and body washed with pale pinkish buff; ears hair brown; tail hair brown above, dull white beneath; feet and underparts white.

Measurements.—Average of 11 (adults and subadults) from Medano Ranch and Hooper, Colorado: Total length, 137 mm. (129–145); tail vertebrae, 63.7 (58–69); hind foot, 17 (16–17.5); ear from notch (dry), 11.2 (10.5–12); greatest length of skull, 20.9 (20–21.8); cranial breadth, 10.1 (9.6–10.4); length of nasals, 8 (7.2–8.6).

For purposes of comparison, measurements were taken of 10 adult specimens of typical *megalotis* from southern New Mexico and northern Chihuahua, as follows: Total length, 149.7 (140–160); tail vertebrae, 75.4 (66–82); hind foot, 17.8 (16.5–19); ear from notch (dry), 12.5 (11.5–13.5); greatest length of skull, 20.9 (19.9–21.8); cranial breadth, 10.1 (9.8–10.5); length of nasals, 8.5 (8.2–9).

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[1] Named for the late Merritt Cary, in recognition of his work on the mammals of Colorado.

Range.—The San Luis Valley, Colorado; specimens examined from Medano Ranch, 23; Hooper, 10; Del Norte, 1.

Remarks.—This race, as shown by the measurements, differs from typical *megalotis* chiefly in its shorter tail and smaller ears—characters that are readily appreciated by direct comparison of series of specimens of the two forms. The skulls show practically no difference in average measurements.

R. megalotis aztecus, described from La Plata, New Mexico, apparently has a slightly larger skull than typical *megalotis*, but there is some question as to the advisability of recognizing the form by name, since it agrees fairly well with *megalotis* in external measurements. Measurements of 14 adults from the type region (La Plata, N. Mex., 8; Aztec, N. Mex., 3; Bluff City, Utah, 3) are as follows: Total length, 142.6 (133–155); tail vertebrae, 67.6 (64–73); hind foot, 17.4 (16–18); ear from notch (dry), 12.5 (12–13); greatest length of skull, 21.8 (20.4–22.7); cranial breadth, 10.6 (10.2–10.8). It will be noted that *caryi* differs from *aztecus* in size of skull and ears more than from *megalotis*.

U. S. Biological Survey, Washington, D. C.

A NEW RACE OF PEROMYSCUS MANICULATUS FROM ARKANSAS

By J. D. Black

In the course of studying a collection of mammals secured in northwest Arkansas at various times during the last three years it has been evident from the first that the representative of *Peromyscus maniculatus* in that region was distinctly different from either the typical specimens of *bairdii*, its nearest known relative, or the aberrant form of *bairdii* found in southeastern Kansas. Further study and comparison of the Arkansas series with typical material of *bairdii* and *pallescens* furnished for that purpose by the United States National Museum and the Field Museum of Natural History, as well as with various other races represented in the University of Kansas collection, has established beyond doubt the presence of a distinct race of *maniculatus*, which although so far as known, limited in range, seems so sharply defined from *bairdii* as to necessitate its separation.

Appreciation should be expressed to C. D. Bunker, assistant curator in charge of the Museum of Birds and Mammals, University of Kansas, for his assistance in many ways, notably his efforts making possible the collection and study of the material in question and the permission to publish the results, and to Hugh Phillips, Eugene Davis, and John Davis, all of Winslow, Arkansas, who have helped secure the type series of the proposed new form.

Peromyscus maniculatus ozarkiarum, new subspecies

Type.—Male adult, skin and skull; no. 10104, Museum of Birds and Mammals, University of Kansas; 3 miles south of Winslow, Washington Co., Arkansas; August 30, 1934; collected by Ruby Black; original number 853.

Measurements.—Type: Total length, 148 mm; tail vertebrae, 61; hind foot, 20; ear, 14. Skull: greatest length, 24.6; basilar length of Hensel, 19.1; zygomatic width, 12.5;

interorbital constriction, 4.1; interparietal length and width, 8.8 x 2.3; nasals, 9.5; shelf of bony palate, 4.4; palatine slits, 4.6; diastema, 6.3; postpalatal length, 9.2; maxillary tooth row, 3.5. Average measurements of 11 adults: total length, 141.4 (134–154); tail vertebrae, 53 (41–61); hind foot, 18.5 (17–20); ear, 14.7 (13.5–16). Skull (10 adults): greatest length, 23.9 (22.6–24.8); basilar length of Hensel, 18.3 (17.4–19.1); zygomatic width, 12.4 (11.6–13.1); interorbital constriction, 3.9 (3.6–4.1); interparietal length and width, 8.3 x 2.3 (8.0–9.1 x 1.9–2.5); nasals, 9 (8.4–9.5); shelf of bony palate, 4.1 (3.6–4.4); palatine slits, 4.7 (4.5–5.1) diastema, 6.3 (5.7–6.8); postpalatal length, 8.7 (8.1–9.2); maxillary tooth row, 3.3 (2.8–3.5).

Distribution.—Known from Winslow, south to the Crawford-Washington County line, from Huntsville in Madison County, and from Gravette, in Benton County. Found only in open fields, but impartially at all elevations from 900 to 2200 feet. Probably ranges throughout most or all of the Arkansas and southern Missouri Ozarks, and westward into northeastern Oklahoma.

Characters.—A small form, similar in size to *bairdii* but with a slightly larger and different skull, and marked coloration distinctions. Feet, tail, and underparts as in *bairdii*, but dorsal area fawn instead of russet or Mars brown, and with only a faintly defined dorsal stripe. The sides and back rather duller and more grayish in fresh than in worn pelage, with the dorsal stripe better defined. Top of the head grayer than the remainder of the dorsal region and with the area before and between the eyes brighter fawn. Adult pelage with a bright cinnamon-fawn patch below each eye. In worn pelage the color is almost pure bright fawn above, only sparsely and finely intermixed with dusky along the sides, and with the dusky arranged in a very faint dorsal stripe slightly darker than the adjoining regions, being never very distinct, sometimes practically absent, and never blackish and sharply defined as in *bairdii*. Shoulder patch and hip patch often tending to become bright cinnamon-fawn. The total color effect of the form is much more like that of *rufinus* of New Mexico than of *bairdii*, but is fawn where *rufinus* is cinnamon-tawny, and in comparable pelage has even a less sharply defined dorsal stripe than *rufinus*.

The skull is slightly larger than that of *bairdii* and less arching, the parietals and interparietals being more angular and flatter than in most specimens of *bairdii*.

Remarks.—The specimens from Huntsville and Gravette, though from much lower elevations than those from the Winslow area, are quite as distinct as the latter, the only justification for the preference of Winslow as the type locality being the more abundant material from that region. A very old individual from Gravette, otherwise perfectly normal, has an apparently abnormal tooth row of 2.8 mm, the three molars all being present, but each greatly reduced in size. The next shortest tooth row in the series is 3.1.

Specimens examined.—Twenty-seven, as follows: **Arkansas**: Gravette, 2; Huntsville, 2; Winslow, 23.

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GENERAL NOTES

FOUR VERMONT RECORDS OF THE BIG-TAILED SHREW

The year 1934 furnished four records for Vermont of the big-tailed shrew (*Sorex dispar*).

The first was taken, August 17, 1934, by G. L. Kirk and G. H. Ross of Rutland, at an elevation of 2,500 feet along a mossy brook. The second and third were taken by the writer at about the same location, August 18 and 23, 1934. It is interesting to note that only one very old water shrew (*Sorex palustris albibarbis*) was taken on the three trips. The *dispar* were all taken in typical *albibarbis* habitat.

The fourth and most interesting record comes from D. E. Kent. A fine specimen was brought in by a cat at his summer place in East Wallingford, elevation 1,800 feet. The house is surrounded on four sides by meadows. The woods surrounding the meadows vary from large open hardwoods to second growth hardwoods. On one side an alder thicket is backed by second growth spruce and hardwood mixed.

This last record for *dispar* was on May 29, 1934, at an elevation of 4,000 feet. Apparently none of these specimens approach *gaspensis*.—F. L. Osgood, *Rutland, Vt.*

BREEDING HABITS OF THE PHYLLOSTOMID BATS

It has been known for years that many bats of the families Vespertilionidae and Rhinolophidae copulate in the autumn, the sperm remaining in the uterus until the following spring, when ovulation occurs. There is some question as to whether these sperm may fertilize the ovum, or whether the inseminated females copulate again in the spring at the time of ovulation; the peculiar fact of the long storage of the sperm is, however, well proved. A recent paper by Hartman (Quart. Rev. Biol., vol. 8, 1933) reviews the literature on this subject. For the fruit-bats, Pteropodidae, we have the statement of Kohlbrugge (Verh. kon. Akad. Wetens. Amsterdam, 2 Sect., 1913) that in *Xantharpyia* there is no retention of sperm such as is found in the European vespertilionids. In the Molossidae, Hartman and Cuyler (Anat. Rec., vol. 35, 1927) found that *Nyctinomus* copulates only in the spring, at the time of ovulation.

Development in the neotropical family Phyllostomidae is virtually unknown. While collecting a series of embryos of *Glossophaga soricina soricina* recently, I obtained some data bearing on the reproductive cycle of this phyllostomid. Females from eastern Matto Grosso, caught between November 23 and December 4, 1933, showed all stages from cleavage to 15 mm. embryos. Of the mature, non-pregnant individuals caught at this time, some had not yet ovulated, others were "pseudopregnant," still others were menstruating (Hamlett, Anat. Rec., vol. 60). In no instance were any sperm found in the reproductive tract. This is in striking contrast to our North American vespertilionids, where the most casual examination of smears or sections at any time prior to ovulation reveals hundreds or thousands of sperm in the uterus.

It is to be concluded that *Glossophaga*, in this region, breeds late in the spring, shortly before the rainy season; there being two or three weeks variation between individuals, as shown by the different sizes of embryos found. The failure to find sperm in any of the non-pregnant females indicates that copulation does not long precede ovulation, as in the vespertilionids and rhinolophids, but probably takes place almost simultaneously with it, as in the Pteropodidae and Molossidae.

The autumn copulation and retention of sperm thus seem to be restricted to the vespertilionine division of the Microchiroptera (following Dobson's arrangement of the families), and must have been evolved after the separation of this from the other bats but before the rhinolophid and vespertilionid stocks had split apart. On this assumption the paleotropical Megadermidae, which are of rhinolophid affinities, will likely be found to show a retention of sperm.

In this connection it is interesting to note that the only vespertilionid known not to have this storage of sperm (*Miniopterus*) breeds in autumn, with pregnancy lasting through the winter, instead of in spring. It has retained the time of copulation typical of the family although the delay in ovulation has been lost, thus returning to a reproductive cycle like that of most mammals.—G. W. D. HAMLETT, *National Research Fellow, Department of Anatomy, Harvard Medical School, Boston, Mass.*

A NOTE ON EPTESICUS FUSCUS

Early in March, 1934, the writer was told about a colony of bats inhabiting the tunnels under the ruins of Fort Henry, near Kingston, Ontario. Investigation of these tunnels disclosed a number of big brown bats, *Eptesicus fuscus fuscus* (Beauvois).

Weather conditions during the winter of 1933–34 were particularly severe. Below zero temperatures were recorded at Kingston for considerable periods and from late in October, 1933, until March, 1934, the thermometer remained below freezing. On the day that the bats were collected the temperature was slightly above freezing. The walls of the tunnels were covered with frost. Water that had collected in the bottoms was frozen solid. Most of the bats were in small clusters clinging together but a few were by themselves. When disturbed they squeaked loudly and seemed to be more or less awake. It is regretted that examination of sex was not made of each cluster as the small number of females might be due to the fact that the sexes either migrate or hibernate separately.

Eptesicus fuscus fuscus has been taken on a number of occasions during the winter in the vicinity of Kingston, mainly from the attics of the public buildings. They are very common during the summer and now that the species has been found hibernating they can be regarded as year around residents. The writer wishes to thank Mr. C. E. Hope of the Royal Ontario Museum of Zoology for preparing, sexing, and measuring the animals.

Measurements (in millimeters) of 13 males (averages and extremes): Total length, 117.7 (112–127); tail vertebrae, 45 (40–53); expanse of wings, 326 (310–345); ear, 14.9 (14–16); tragus, 8.3 (7–9); weight (grams), 14.2 (13–16). Of 5 females: Total length 123.4 (121–125); tail vertebrae, 46.7 (41–50); expanse of wings, 339.5 (330–348); ear, 15.3 (15–16); tragus, 8.3 (8–9); weight (grams), 15.2 (14–16).—G. C. TONER, *Gananoque, Ontario.*

TADARIDA MEXICANA FROM CASTLE ROCK, KANSAS

On the 10th of October, 1934, the Museum of Birds and Mammals, University of Kansas, received from Peter Meier an adult female specimen of *Tadarida mexicana*, killed two days before near Castle Rock on the Gove-Trego County line. The specimen has been preserved as skin and skull.

This is the second recorded specimen from Kansas, the first, collected September 6, 1933, by C. W. Hibbard near Aetna, Barber Co., having been previously reported ("A Revised Check-List of Kansas Mammals," C. W. Hibbard, Trans. Kansas Acad. Sci., vol. 36, 1933, p. 234). It is to be expected that the species will prove to be fairly common in Barber and Comanche counties, and probably others of the southern tier of counties. The large bat caves just across the state line in Oklahoma are known to be frequented by this species, but its occurrence in the Gove-Trego county section is an extension northward of approximately 150 miles beyond its previous known range.—J. D. BLACK, *Museum of Birds and Mammals, University of Kansas, Lawrence, Kansas.*

MYOTIS THYSANODES IN SOUTH DAKOTA

On August 10, 1929, P. N. Moulthrop and G. W. Phillips, field collectors for the Cleveland Museum of Natural History, obtained two specimens of *Myotis thysanodes*

Miller, in the Jewel Cave, Custer Co., South Dakota. The capture of these specimens greatly extends the known range of this species to the northeast and constitutes, so far as the writer has been able to discover, the first record of the animal's occurrence in South Dakota.

Miller and Allen mention the existence of an old alcoholic specimen labeled St. Louis, Missouri (U. S. Nat. Mus. Bull. 144, p. 127, 1928) but seem to be a bit doubtful as to the authenticity of the record because of its distance, presumably, from the main range of the species as it was then known. The South Dakota record may perhaps make the Missouri one seem less improbable.—B. P. Bole, Jr., *Cleveland Museum of Natural History, Cleveland, O.*

OCCURRENCE OF THE SPOTTED BAT AT RENO, NEVADA

Several years ago Donald D. McLean of the California Division of Fish and Game told me of the taking of a spotted bat at the University of Nevada when he was a student there. The animal was saved as a stuffed study skin, with skull inside, by Professor C. L. Brown, and by him and Professor Peter Frandsen of the Department of Biology there, has recently been placed for safe-keeping in the Museum of Vertebrate Zoology.

The specimen, M. V. Z. no. 65171, now with skull removed, Mr. McLean tells me was taken about September 10, 1922, in the zoological laboratory on the campus of the University of Nevada, at Reno, by a person unknown. Previously the species has been recorded (see Ashcraft, Journ. Mammalogy, vol. 13, p. 163, 1932) from only five localities as follows: Mesilla Park, New Mexico; Yuma, Arizona; Piru, Mecca, and Yosemite Valley, California. Thus, it may be seen that the taking of this specimen of the spotted bat, *Euderma maculatum* (Allen), at Reno, Nevada, marks a considerable extension of its known geographic range to the northward.—E. Raymond Hall, *Museum of Vertebrate Zoology, University of California, Berkeley, California.*

THE CLOUDED LEOPARD IN WESTERN CHINA

In the classical work of Milne-Edwards (Rech. Mamm., vol. 1, p. 208, 1868–74) on the mammals collected and observed by Pere David in northwestern China, there is a paragraph containing the following statement: "Il y a encore, dans le nord de la Chine, un carnassier de moindre taille dont les chasseurs ont souvent parlé à M. l'abbé David, mais sans pouvoir lui en procurer la dépouille. Ils appellent cet animal le *Thou-pao*, et le dépeignent comme étant bas sur jambes, de couleur obscure et sans taches orbiculaires. C'est peut-être le *Felis macroscelis* de Temminck ou *Felis nebulosa* de Griffith. . ." This report was recognized by Elliot in his Monograph of the Felidae, where "Moupin" was included in the range of the clouded leopard, but subsequently it has been disregarded.

Recently the skin of a clouded leopard has been received at Field Museum which seems to confirm the early report and to indicate that the species may be of regular occurrence in western China. This skin is from the market in Kiating, Szechwan, and is said to have originated in the mountains of Mapien, southwest of Kiating, a locality near the Min River between Chengtu and Suifu. The skin was purchased from a dealer by Mr. L. A. Lovegren of Minneapolis, Minnesota, who was for some years engaged in missionary work in the region and whose interest in mammals was stimulated by Mr. Floyd T. Smith during his Chinese expedition for Field Museum. Mr. Lovegren states that two skins came under his notice in Kiating, one of very large size which he saw displayed in 1932, and the one under consideration which he obtained in 1933. He also reports having seen, in the fall of 1932, a captive living animal in Chengtu, which was said to have died in February, 1933. This was stated to be from a very high range of mountains northwest of Kwan Hsien. In conversation with an old hunter in

Kiating, he was told that this man had seen only four or five skins in his lifetime. It is, of course, possible that both of the market skins and even the living animal could have been brought from a greater distance than alleged. The presumption, however, is in their favor and it must be admitted that their history compares well with that of other examples of the species, since these also have been in practically all cases from native sources. The animal is nowhere common and specimens with full and exact data are almost unknown.

The skin in hand offers some evidence for itself, not conclusive, but at least suggestive. Although in somewhat worn condition, the pelage is thicker and longer than in others from more southern localities and it shows some other slight peculiarities. In an attempt to determine the significance of these, comparison has been made with skins available in the larger American museums, for the loan of which I am indebted to the institutions mentioned. The result, however, has been the accumulation of only four other skins, one from Yenping, Fukien, in the American Museum of Natural History, one from Hainan in the Museum of Comparative Zoology, another from Hainan in the U. S. National Museum, and one from Tonkin, Indo-China in Field Museum. Two from Borneo, reported as being in the U. S. National Museum, have not been examined. The species has been exhibited in various American zoological gardens, including New York, Philadelphia, Washington, and St. Louis, but preserved specimens in museums are rare.

Variation in color and markings among the five skins available is rather less than might be expected. Minor differences are easily detected but the general pattern is fairly constant. In skins which are obviously in fresh unworn pelage, the dark markings are deep black, but in worn pelage this changes to brown, especially on the under parts and on the tail. The skin from Szechwan is obviously somewhat worn, although the pelage is exceptionally thick and full. Hairs on the back and sides measure about 30 mm. in length, whereas the longest on any of the other skins scarcely exceed 20 mm. In general, the dark markings are not so sharply defined as in the other skins and there is much less tendency to the formation of completely closed outlines. Nearly all the dark markings on the sides are lunulate or roughly U-shaped, that is, they are open in front instead of being nearly or quite closed. The hindmost of these markings, lying just anterior to the base of the tail and next to the divided black dorsal line, is completely divided into three crescentic spots in the Szechwan skin, whereas in the others it forms an elongate, somewhat reniform marking, partially open in front but with the lateral boundaries entire. Variation in its form is evident, but it seems not improbable that a general distinction might be based on it if a series of skins were available.

The type of Griffith's *Felis nebulosa* was said to be from Canton and, as already stated by G. M. Allen (Amer. Mus. Novit. no. 360, p. 12, 1929), the skin from Fukien may be regarded as typical. For the same form to range westward and northward into Szechwan would not be improbable. Until better material can be examined, therefore, any nomenclatural distinction of the Szechwan animal is inadvisable. The clouded leopard of Formosa, which has received the name *brachyurus*, is perhaps distinguishable by its shorter tail, which the original describer stated to be only 21 inches in length. In the Szechwan specimen the tail is quite long, measuring in the native-tanned skin about 33 inches.—Wilfred H. Osgood, *Field Museum, Chicago, Illinois.*

BEARS IN SAN DIEGO COUNTY, CALIFORNIA

A newspaper account in the San Diego Union on June 3, 1934, of the recent capture at Potrero, San Diego County, California, of a bear that had just weaned her cubs, prompted the writer to make some inquiry into the general subject of bears in this county. The report stated that the bear was shot by J. W. Harris, beekeeper, and a neighbor, George A. Smith, after she had visited Smith's apiary and had wrecked all but

four of his 25 bee colonies. It continued: "The only other bear reported killed in San Diego County in recent years was shot by Frank B. Lane when it visited his bee farm in Mason valley, near the Laguna Mountains five years ago." The last-named animal was evidently a myth, as Mr. Lane wrote me, in response to my inquiry, that he had never seen a wild bear in his life.

Of the Potrero bear I learned all the facts. I examined the pelt, which was that of a black bear in the brown color phase, and I secured the skull, which has been added to the collection of the San Diego Society of Natural History. George A. Smith, who brought the pelt and skull to San Diego, stated that the animal weighed 220 pounds and that there was a small amount of milk in her breasts, indicating that she had cubs which were just about weaned. He said she was trapped in a bear trap and had dragged the trap and the log to which it was attached, and had climbed about fifteen feet up in a tree where she was shot with a .22 cal. rifle. He believed that more than one bear must have been around, since as much as 100 pounds of honey had been consumed in one night.

Black bears have not inhabited San Diego County or Lower California, Mexico, within historic times and the presence of this bear some 200 miles south of its known normal range indicated the result of liberation; but as an additional check the skull was sent to the Museum of Vertebrate Zoology, University of California. Dr. E. Raymond Hall identified it as *Ursus americanus californiensis*, which is the black bear of the Sierra Nevada. It is hardly possible that the animal had wandered from there into San Diego County through the thickly settled regions to the north, or that it was one of 28 bears removed from Yosemite National Park in October and November, 1933, and liberated in Crystal Pines Park, San Bernardino Mountains, Los Angeles County, California (information by kindness of C. A. Harwell, Yosemite Park Naturalist). More likely it was an individual or descendant of bears known to have been turned loose in San Diego County.

E. H. Glidden, local Deputy Game Warden, informed me: "Between 1918 and 1919 the Marines, or some other branch of the Service, had an encampment at Campo and had as mascots two bears. At the time the encampment was broken up the bears were liberated in that vicinity. From there they strayed up into the Cuyamacas and did considerable damage to bee ranches, by upsetting stands, etc. I know of none that have been killed before this one, although tracks have been noticed through the Lagunas and Cuyamacas as far as Descanso." Mr. Glidden stated subsequently that there might have been only one bear liberated from this encampment, not two.

Adolph Muehleisen, San Diego sporting goods dealer, states that, in addition to the pet or pets referred to by Glidden, a black bear mascot was released about 1917 by the Engineers Corps of the Army, which had been sent from Camp Kearney to do some experimental road-making and bridge-building in the Cuyamaca Mountains.

It thus seems evident that black bears have been wandering about San Diego County for fifteen or more years. J. W. Harris, of Potrero, who helped to make the recent capture, wrote: "An Indian at Live Oaks told me that he saw bear tracks at the Campo Indian Reservation about six years ago, but I did not think much about it at the time."

With regard to the grizzly bear in San Diego County, it is noteworthy that the type of the southern California grizzly (*Ursus magister*) was taken in this county in 1900 or 1901. The exact locality is given by Dr. C. Hart Merriam in his description (Proc. Biol. Soc. Washington, vol. 27, 1914, pp. 189–190) as Los Biacitos, head of San Onofre Canyon, Santa Ana Mts., southern California. As "the head of San Onofre Canyon" might be in Riverside County, I wrote the postmaster at San Onofre, who replied: "Los Biacitos is located in San Diego County, about 10 miles from the northwest corner."

Of this species Dr. Merriam states (*loc. cit.*): "Size of male, huge (estimated weight over 1400 pounds), largest of the known Grizzlies, considerably larger than *Ursus californicus* of the Monterey region and even than *Ursus horribilis*, the great buffalo killing Grizzly of the Plains (only equaled by the largest *alexandrae* of Kenai Peninsula)." Not

being in the stock raising business, we must confess to a feeling of sadness that, as the result of extinction, the romantic possibility of spying one of these noble animals in a remote fastness of southern California is now gone forever!

Frank Stephens, of the San Diego Natural History Museum staff, now in his 86th year, has never seen a grizzly in San Diego County. But another old-timer, Charles F. Emery of Point Loma, has provided me, under date of August 23, 1934, with the following "True Bear Story:"

"When a boy thirteen years of age, in the spring of 1871, I was living in a log house in Pine Valley, this county. At that time there were bears, lions, wild cats, foxes, and many other wild animals in the mountains surrounding the valley. One evening my mother and I saw a large bear walking along on the east side of the valley and the next morning we found one of our cows badly torn and wounded. She had evidently tried to protect her calf from the attack of the bear.

"A few days later, while I was learning to ride horseback, I rode up the valley to the south, to a spring of water near where the present hotel and store are located. As I came near the spring the old horse I was riding became frightened; he snorted and wanted to turn towards home. I looked down at the mud and water and saw a very large fresh bear track. You can be assured I returned home very fast to tell the folks that there was a big bear up there. Then our hired man, John Ross, said he would go up the trail into the Laguna Mountains and get a cattle man named John Ames to bring his dogs and his cow-men down to go in search of the bear. They came down and at once followed the tracks of the bear over into a valley about three miles south, where the dogs cornered the bear against some large rocks. The cow-boys then threw their ropes on him and let the dogs fight him awhile and then shot the bear with their pistols.

"Some time after that I found the head or skull of the bear and hung it in the forks of an oak tree and named the place 'Little Bear Valley.'

"One of the last of the grizzly bears was killed in Cuyamaca Valley by a rancher who placed a gun-trap at his hog pen. The grizzly set off the trap and was killed."

A letter to Mr. Emery inquiring as to the date of this last grizzly episode brought the reply: "I am not sure of the exact date, but I am sure it was in the early seventies, not long after the one was killed at Pine Valley." He further stated that Cuyamaca Valley is the valley now occupied by Cuyamaca Lake.—CLINTON G. ABBOTT, *San Diego Society of Natural History, San Diego, California.*

SOME MARINE MAMMALS FROM A SOUTHERN CALIFORNIA SHELLMOUND

One of the best preserved shellmounds in southern California is at Point Mugu, Ventura County. The mammalian material has been recovered in good condition and is readily identified in the majority of cases. During the process of identification certain facts of considerable interest were observed.

Thus far there have been no records of the Alaskan fur seal (*Callorhinus alascanus*) south of Pt. Conception, the southern limit of its winter migration along the California coast. This long migration includes only the adult females, since the young seals and the adult males are known to remain farther northward during the winter. At Point Mugu we have found between 4 and 5 per cent of the Pinnipeds present in the shellmound collection to be identifiable as *Callorhinus alascanus*, adult females. There are also a few very immature bones, presumably those of fetuses.

Other classified otariid specimens include *Zalophus californianus*, the California sea lion; *Eumetopias stelleri*, the Steller sea lion; and *Arctocephalus townsendi*, the Guadalupe fur seal. The last form comprises the most numerous species of pinniped present, or between 80 and 90 per cent of the total material.

The phocids are represented by both *Phoca richardii geronimensis*, the California

harbor seal, and *Mirounga angustirostris*, the northern elephant seal, but in very small numbers, approximately 1.5 per cent of each, consisting mainly of juveniles.

Approaching *Arctocephalus townsendi* in frequency is *Enhydra lutris nereis*, the southern sea otter, mostly adult with very few juveniles.

We presume that these marine mammals were found either on the mainland, on the islands, or in the Santa Barbara Channel, since the Indians of Point Mugu were pelagic hunters and most likely pursued game within those confines. At the present time, the two sea lions and the harbor seal are still residents along the California coast, but there is less certainty concerning the other species. In late years, the sea otter has been rarely seen. The Guadalupe fur seal probably has disappeared from north of the Mexican line and, if not already extinct south of the line, is approaching that status. The elephant seal, although holding its own on Guadalupe Island, is extinct in southern California. The Alaskan fur seal still occurs in abundance on the Pribilof Islands in Bering Sea, and probably still pursues its migration off the California coast.—GRETCHEN M. LYON, *University of California at Los Angeles, Calif.*

NOTES ON THE VOICE OF MARMOTS

In the summer of 1934 I made a somewhat extended trip in the mountains of southern Colorado, accompanied by Robert Potts of Denver. I was especially interested in the marmots; Mr. Potts, who did practically all the collecting of these animals, made the following memoranda on their various notes, and has kindly permitted me to publish them.

A marmot's curiosity almost always gets the better of his caution in about ten to fifteen minutes, or, perhaps, he is used to having dangers that threaten pass away within that time. He is not greatly startled by the noise of a gun, nor greatly troubled by the adjacent impact of a missing bullet, but the marmot takes most rapidly to his hole if the huntsman makes a sudden movement, even if at some distance.

The marmots that whistle are the easiest to take; with almost every whistle they will come into better view, but there are those that take a quiet look and disappear. Those of the latter sort generally remain longest in their holes. The marmot's whistle does not seem to be an alarm note at all, but appears to be more in the nature of expressing doubt or inquiry. Other marmots in the neighborhood seem to be affected by the whistle only in so far as most of them, on hearing it, will go to a point of vantage. In fact, when one has whistled, I have seen several come from their holes to get into a good position to see.

There is, however, an alarm call that is not so loud as the whistle and is more of a coughed '*keyuck*,' or it might readily be interpreted as '*chuck*.' I found it rarely given, but the marmots in the neighborhood at the time certainly hurried to their holes. At one time, however, one of seven marmots in view when the call was given stopped on a lookout right by the hole and took up this danger signal, giving it several times and then changing to the whistle and, shortly after, the other six reappeared.

There is, besides, a low whistling sound given from down in the hole, which also seems to express an inquisitive and questioning mood, as the marmots giving it invariably come from their holes within a very short time. As soon as they reach a lookout spot the loud intermittent whistle is given. There is a fourth marmot call which will not be heard unless the observer is very close to a pair or more of undisturbed animals that are playing, feeding, or sunning themselves. A fifth call is a variation of the whistle and consists of running a number of the notes together in an undulating fashion.

When badly wounded, but not instantly killed, a marmot may still give another call, a medium low 'barking' cry. Also, at such a time, a low whine.

After a family of marmots have gone into their holes the young come out first; the

female's curiosity brings her forth next, and the male, more cautious or perhaps less curious, seems to come forth much later. However, a much frightened male will appear before a frightened female.—EDWARD R. WARREN, *1511 Wood Avenue, Colorado Springs, Colo.*

A GOPHER AT WORK

July 21, 1934, I was camped near Blue Lake, Huerfano County, Colorado. The evening of that day, my companion, Bob Potts, and I were sitting by our camp fire and we had an interesting time watching a pocket gopher (*Thomomys fossor*) working on the opposite side of the fire from us. The animal was about 10 or 12 feet distant from us, busily engaged in pushing earth out from its burrow. It gave us little attention except to look over at us whenever it pushed out a load. I think that I saw it the first time that it came out. It was still broad daylight and we could see everything distinctly.

Often the animal came so completely out from its hole that its entire body could be seen. It was evidently a young one, for it was no larger than a good sized field mouse. At first the earth was pushed out directly in front of the hole until a good sized mound had accumulated there; then the dirt was dumped at the left side until there was another good pile, and then a little was dumped on the other side. I think that the animal made fifty trips altogether. I began counting after watching a short time. It also made several little openings a short distance to one side, but by this time dusk had fallen and we could not see clearly what it did there, except that we thought at one time that it pulled in some grass or other plant for food.

When I examined the place the following day I found the hole closed and a mound 350 mm. long in front of the opening. This was 270 mm. wide on the left side and 190 mm. on the right. The distance between this hole and the most distant of the others we had seen the gopher open was 790 mm. Two other holes were about on a line between these two, 290 and 620 mm. from the main burrow. Other small holes were to one side.

About four o'clock the next afternoon, as I was making a fire under the camp stove, I happened to glance over to the gopher workings and saw the animal come out of a new hole at the edge of the mound. It was evidently getting its evening meal, for it hastily bit off grass and other green stuff and put it in its cheek pouches, always taking a hurried glance at me between bites. When the pouches were filled it retired into the burrow, but soon reappeared and gathered more food. After emptying the pouches a second time, it came out and pushed out enough to close the opening, and was not seen again all that evening. As we moved camp the next morning I had no opportunity for further observations, but considered myself fortunate to have been able to watch an animal which is so elusive or secretive in its ways.—EDWARD R. WARREN, *1511 Wood Avenue, Colorado Springs, Colo.*

NAPAEOZAPUS INSIGNIS INSIGNIS IN OHIO

The first recorded specimen of the woodland jumping mouse taken in Ohio was obtained on August 30, 1925, by A. B. Fuller of the Cleveland Museum of Natural History (Enders, Occas. Papers Mus. Zool., Univ. of Michigan, no. 212, April, 1930, p. 16). Subsequent examination of alcoholic material in the Cleveland Museum's collection reveals that this record was antedated by a few weeks, a half-grown young animal having been brought in on July 5 of the same year by Miss Jean McNamae.

During the years since 1925 a small series of a dozen specimens has been assembled, most of them collected by the writer during the summer of 1933. Enders, in the citation mentioned above, states that the specimen collected by Mr. Fuller was taken in beech-maple forest. All of the specimens taken since 1925, however, have been taken in hemlock or pine-hemlock environments at various points on the drainage of the Chagrin River in Lake, Geauga, and Cuyahoga Counties. The preferred habitat of the animal

in Ohio seems to be wet, cool ravines where hemlock predominates, with some beech, maple, and yellow birch. Despite extensive trapping in many of the bogs of northeastern Ohio, no specimens have been taken in such places, although some were found in small boggy localities at the foot of hemlock-covered slopes. The mammal associates of *Napaeozapus* seem to be *Zapus hudsonius hudsonius*, *Sorex fumeus fumeus*, *Blarina brevicauda*, and *Peromyscus leucopus noveboracensis*.

The woodland jumping mouse has not yet been reported from Ashtabula County, despite considerable trapping along the Pennsylvania line.—B. P. Bole, Jr., *Cleveland Museum of Natural History, Cleveland, Ohio.*

A CREAM VARIATION OF PELAGE COLOR IN PEROMYSCUS

A variation in pelage color resembling cream of *Rattus rattus* (Crew, 1923, Journ. Heredity, vol. 14, pp. 221–222) has been observed in a single individual of the deer-mouse *Peromyscus maniculatus gracilis*. So far as could be determined the color variation of this individual was not inherited.

The cream-colored individual, a young male, was secured alive in the summer of 1922 by Drs. Frank N. and Frieda Cobb Blanchard, at Douglas Lake, Cheboygan County, Michigan. When taken, the mouse was very pale in color, almost white, but had black eyes. The mouse was given to me for study in May, 1925, at which time it had become somewhat tinged with yellow and would be described as pale cream in color.

This male cream-colored mouse was mated with a normal agouti female from Elmira, Otsego County, Michigan. Elmira is less than forty miles from Douglas Lake and the same subspecies of deer-mouse occurs in both localities. Seven young were born from this mating, all normal agouti like the mother. A back-cross of these F_1 hybrids to the cream-colored male was attempted, but no offspring were secured, perhaps because of the advanced age of the cream-colored individual.

Matings of the F_1 generation mice among themselves produced thirteen F_2 mice, all of which were normal agouti in color. The stock then was turned over to H. W. Feldman, who made numerous other matings and secured a considerable number of progeny, all of which were normal in color. None of the descendants of the cream-colored male showed the least tendency to resemble their abnormal ancestor, and the character was apparently not inherited.—Lee R. Dice, *University of Michigan, Ann Arbor, Michigan, and Cranbrook Institute of Science, Bloomfield Hills, Michigan.*

OCCURRENCE OF GROUND SQUIRRELS ALONG HIGHWAYS

During the summer of 1934, while travelling for the Bureau of Plant Industry in Wyoming and Nebraska, the writer noted that ground squirrels, mostly *Citellus elegans* (Kennicott), were especially abundant along national highways and other heavily travelled roads. The following explanation is offered. At night jack rabbits are blinded by automobile lights, and in their confusion often bound into the path of the oncoming car. Commonly eight to twelve jack rabbit carcasses may be counted in stretches of no more than a mile in length. Ground squirrels apparently find these carcasses an excellent source of food, and numbers of them may be seen feeding on each rabbit. Ordinarily ground squirrels are considered to be vegetable feeders, as indicated by the group name "spermophiles." The ground squirrels usually retreat from the road upon the approach of a car and are not often killed by autos. Also, the enemies of the ground squirrels, chiefly carnivora and hawks, are largely frightened away by the traffic. However, on several occasions weasels were seen pursuing the rodents. But for the most part, the ground squirrels find abundant food in relatively safe situations. The only other animal, excepting insects, observed feeding on the rabbits was the black-billed magpie. —Robert F. Martin, *Shinnston, W. Va.*

TIME OF APPEARANCE OF YOUNG BEAVERS IN YELLOWSTONE NATIONAL PARK

The writer was interested to note some time ago, in reading Warren's account of the beaver (*Castor canadensis missouriensis*) in the Yellowstone, the statement that he had not seen young beavers out of their homes at the time usually given—late June and July—for their appearance in that region. He says that in 1921 young beavers were not seen in the Tower Fall region of the park, where he was at the time making observations, until August 22; and again in 1923, although he was constantly on the watch until August 25, no young of that season were seen outside in the water at all although they were heard distinctly within the huts.

Having spent the summer of 1929 in this same region and conducted "beaver parties" of tourists daily throughout the season, I distinctly remembered that the young had been observed in the water swimming about much earlier than August. My notes taken during that time were referred to and under date of June 30, I found: "On the beaver trip this evening a baby beaver was seen for the first time swimming about in the water." again the next evening, July 1, this note: "Two baby beavers were seen this evening; They could be plainly seen by the entire party." Thereafter, as long as this pond was visited, until about the middle of August, these two young could be seen out daily swimming with their parents.

The pond where these beavers were was along the main loop road about a mile from Roosevelt Lodge on the way to Tower Fall. They were the only beaver in it. There were no "yearlings" and the hut was located at the water's edge on the far side from the highway. I was told by the park ranger and others that this pair of old beavers had located in this pond the previous fall. Whether the hut had been built by them or was an old abandoned one that they had renovated, I could not tell, but it did not appear to be entirely new. Later in the season the water became so low in this pond that the beavers would not come out regularly in the evenings to perform for our party so we had to transfer to a new site on the "Petrified Tree" road near the main highway where beavers had recently become active and had built a new dam across this creek draining out of Lost Lake above.—Otis Wade, *Department of Zoology and Anatomy, University of Nebraska, Lincoln, Nebr.*

OBSERVATIONS ON THE WHITE WHALE

On July 19, 1934, I travelled by boat from St. Simeon, Quebec, down the St. Lawrence River to the town of Tadousac, within the mouth of the Saguenay River, and return. Where the waters of the two rivers join there is a sharp line of demarcation, miles in length, the pale green, salty waters of the St. Lawrence on the convex side of the line, and the clear, coffee-colored flow of the Saguenay on the concave side. During the trip to Tadousac, when the tide was just past flood, nothing of interest was noted.

On the return trip a couple of hours later, at approximately 3 P.M., white whales (*Delphinapterus leucas*) began to appear well within the Saguenay waters, extending as far as one could see down the St. Lawrence and for perhaps five miles up that river. Over most of this area the surface was unruffled and the number of whales was such that one was reminded of whitecaps, particularly well defined and somewhat less numerous than whitecaps would ordinarily appear. I estimated the number of individuals at not less than 800, with the possibility that there were many more stretching beyond my field of vision.

The white whales occurred singly, or by twos and threes, the latter suggestive of family parties as one of the three was usually smaller than the other two. There was no suggestion of any further gathering into parties, the impression gained being merely that single animals, pairs, or trios had been independently attracted to a favorable food supply. They were merely cruising here and there, slowly, in all directions. Inter-

spersed were a dozen or so pike whales (*Balaenoptera acutorostrata*), those seen being in pairs.

The white whales would not suffer a close approach; as we passed through their midst for several miles there was an area in which no individuals appeared within about 150 yards of the boat. Hence it is likely that one could expect no success in hunting them from a motor boat, whereas the use of a sailboat might prove more promising.

It was not easy to observe details through a 6 power glass. Nevertheless the impression was gained that two sorts of actions were involved. One comprised the simple rocking motion characteristic of porpoises, in which the top of the head appears, synchronous with the action of breathing, and the back slowly rolls into view, the latter action being especially deliberate in the case of the belugas. At other times the snout as well as the top of the head appeared and was held in view for a longer period, while the opening of the blowhole could be clearly seen. Less of the back was then shown and for a shorter period.

The rate at which these cetaceans were travelling was certainly no faster than a man could walk. It has been charged by commercial fishermen that they are destructive to salmon, but certainly these white whales could not have been engaged in salmon fishing, for they travelled too short a distance between appearances to have been chasing salmon. Furthermore their conformation is not that of a speedy aquatic type and it is probable that they could not habitually pursue any fish as large and active as the salmon with much expectation of success.—A. Brazier Howell, *Department of Anatomy, Johns Hopkins University, Baltimore, Md.*

FLUCTUATIONS IN SMALL MAMMAL POPULATION

A careful check of the small mammal population near Rutland, Vermont, during the spring and summer of 1934 indicated that the numbers had diminished beyond anything we have previously known.

One theory that presents itself is that at the end of our severe winter (1933–1934), with the ground frozen to a depth of three or four feet in many places, a thaw and rain filled large numbers of underground burrows. The weather immediately became severe, freezing the water that had penetrated the ground.

The scarcity of rodents was far more than a seasonal one. One hundred traps set one night in June, in ideal territory not previously trapped this season, produced only six specimens. A male weasel, *Mustela noveboracensis*, taken in April, was heavily parasitised and had several short porcupine quills imbedded in its neck, head, and shoulders. Tracks in late winter indicated that weasels left their usual haunts and hunted 'cross lots,' vainly trying to find food. I do not believe that this sudden change in habits was due to the approach of the breeding season.

During the fall of 1934, mice, shrews, and other species, with the possible exception of weasels and red squirrels, were abundant. Weasels seemed to be entirely absent in our area. A great variety of mouse food was plentiful and an immense increase in numbers was noted in several widely separated localities. Litters were raised as late as September and some as late as early October. Chipmunks were especially abundant. It should be noted however that a very small percentage of all specimens taken this fall were fully adult. While this indicates a wonderful speeding up of reproduction we are at a loss to account for the survival of the large number of parents necessary to furnish the spring and summer breeding stock. Fifty-four traps secured sixteen specimens in one night during November. This same trapping ground yielded seven specimens to the hundred traps during early summer.

Accurate figures indicating the relative abundance of mice, shrews, and moles at varying times during the year have been kept, but it will require several years to determine if there is a definite cycle of abundance or merely a fluctuation from year to year. It is quite likely that food and natural enemies will prove to be the determining factors and because of them a definite cycle will be hard to trace.—F. L. Osgood, *Rutland, Vt.*

RECENT LITERATURE

Holman, John P. SHEEP AND BEAR TRAILS. With an introduction by Robert A. Bartlett. New York: Frank Walters, Grand Central Palace. 8 vo., pp. XVI + 211, frontispiece, 23 plates in text. Cloth, $3.00, 1933.

One might well believe there are sufficient hunting books with their usual sameness in describing the preparations for the trip, the hardships endured in finding the game, the thrill of slaughter, the difficulties encountered in packing out the spoils, and the aftermath of pipe dreams. Holman's book is different. He makes light of his hardships, which prove thrilling and entertaining experiences, for after all did he not anticipate these as a worthwhile part of his expeditions? Wilderness scenery and outdoor exhilaration are tersely and vividly described, though many an author would be more verbose and less descriptive.

In the five chapters the writer describes a hunting trip after sheep in Alaska, expeditions after big bears in the Atnarko region and up the Kitlope in British Columbia, and closes with a series of letters from Ralph A. Edwards, designated as "The Keeper of the Swans." Throughout the text one finds notes on the habits and distribution of many animals other than those sought for sport by the author. Thus in the region of Benjamin Creek, Alaska: "A little later we discovered a wolverine. He was loping along about a hundred yards away, travelling fast, with a long, rangy stride, stopping every once in awhile to take in the country, swinging his head in jerky fashion, tongue hanging out, then lowering it again with a quick motion and continuing on his way."

To the reviewer the book increased in interest from page to page as he progressed, and past-midnight kilowatts found him reading the closing chapter. One might call it light reading fit for a serious-minded naturalist.—HARTLEY H. T. JACKSON.

ABEL, OTHENIO. Darstellungen des Höhlenbären durch den paläolithischen Menschen. Palaeobiologica, vol. 5, pp. 7–45, pl. 1, figs. 9. 1933.

ANDERSON, R. M. Notes on the distribution of the hoary marmots. Canadian Field-Nat., vol. 48, no. 4, pp. 60–63, fig. April 2, 1934.

——— Sorex palustris brooksi, a new water shrew from Vancouver Island. Canadian Field-Nat., vol. 48, no. 8, p. 134. November 1, 1934. (New: *Sorex palustris brooksi*.)

——— Effect of the introduction of exotic animal forms. Proc. 5th Pacific Science Congress, Victoria and Vancouver, B. C., 1933, Univ. Toronto Press, pp. 769–778. 1934.

——— The distribution, abundance, and economic importance of the game and fur-bearing mammals of western North America. Proc. 5th Pacific Science Congress, Victoria and Vancouver, B. C., 1933, Univ. of Toronto Press, pp. 4055–4073, 13 maps. 1934.

——— Mammals of the eastern Arctic and Hudson Bay. Canada's Eastern Arctic, Dept. Interior, Ottawa, pp. 67–108, figs. 9, with folding map. 1934.

ANONYMOUS. The wild animals of the Indian Empire and the problem of their preservation. Pt. 2. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 1, [suppl.] pp. 59–96, pls. 16–36. April 15, 1934.

——— Der Biber in der Ukraine. Priroda, Verlag Akad. Wiss. USSR, nos. 8–9, pp. 106–109, figs. 4. 1933. (In Russian.)

ARAMBOURG, C. Sur la longévité, en Afrique du Nord, du genre Rhinocéros pendant la période quaternaire. Comptes Rendus Acad. Sci., Paris, vol. 192, no. 17, pp. 1044–1046. April 27, 1931.

ARGYROPULO, A. I. Contributions to the knowledge of the genus *Rattus* Fitzinger (1867). Bull. Inst. Zool. Appl. et Phytopath., vol. 4, pp. 63–87, fig. 1, pl. 1. 1928. (In Russian.)

——— A key to the rats of the genus Rattus Fitzinger of the USSR. La Défence des Plantes, vol. 5, nos. 5–6, pp. 663–666, figs. 2. (1928) 1929. (In Russian.)

——— Remarques sur la systématique de la souris domestique (*Mus musculus* L.) (Mammalia). Trav. Inst. Zool. Acad. Sci. de URSS, Leningrad, vol. 1, pp. 223–228. (1932) 1933. (In Russian, with German diagnoses.) New: *Mus musculus vinogradovi, M. m. tomensis ruſiventris, M. m. tomensis amurensis, M. m. variabilis, M. m. decolor.*)

——— Matériaux pour servir à la connaissance des Rongeurs de l'Asie Centrale. III. Une sousespèce nouvelle de l'Hamster (*Cricetus cricetus* L.) de la région de Semiretschje. Trav. Inst. Zool. Acad. Sci. de l'URSS, Leningrad, vol. 1, pp. 235–237, (1932) 1933. (In Russian.) (New: *Cricetus cricetus fuscidorcis.*)

——— Die Gattungen und Arten der Hamster (Cricetinae) der Paläarktis. Trav. Inst. Zool. Acad. Sci. de L'URSS, Leningrad, vol. 1, pp. 239–248, (1932) 1933. (In Russian, with German summary.) (New: *Allocricetulus* for *Cricetus eversmanni, A. e. beljaevi, Cricetulus migratorius coerulescens ognevi.*)

ARIMA, SHIZUKA. Experimental inquiry into the transmission of rat-bite fever among rats, Part 2. Successful transmission of rat-bite fever by feeding infected organs to white rats. Philippine Journ. Sci., vol. 58, no. 2, pp. 179–181. February, 1934.

BACHOFEN-ECHT, AD. Das Vorkommen von *Capreolus* im Plistozän Württembergs. Palaeont. Zeitschr., vol. 13, no. 3, pp. 238–251, figs. 7. September 15, 1931.

——— Darstellung des Lebensbildes von Megaceros nebst Bemerkungen über dessen Variationsbreite. Palaeobiologica, vol. 5, pp. 116–125, figs. 10, pls. 11–12. 1933.

BAIER, WALTHER. Der Schädel des bayrischen Landschweines. Eine Monographie über das noch vorhandene Schädelmaterial, zugleich eine Studie über postembryonale Entwicklungsvorgänge. Zeitschr. für Anat. und Entwickl., Berlin, vol. 97, pt. 6, pp. 665–724, figs. 33. June 7, 1932.

BARBOUR, E. H. A new rhinoceros mount, Trigonias osborni. Nebraska State Mus., vol. 1, bull. 38, pp. 299–302, 2 figs. May, 1934.

——— A mounted skeleton of Megabelodon lulli. Nebraska State Mus., vol. 1, bull. 39, pp. 303–310, figs. 177–181. June, 1934.

——— The Thurston County mastodon, Mastodon grangeri, sp. nov. Nebraska State Mus., vol. 1, bull. 35, pp. 287–290, 1 fig. May, 1934. (New: *Mastodon grangeri.*)

——— A new ovibovine, Symbos convexifrons, sp. nov. Nebraska State Mus., vol. 1, bull. 37, pp. 295–298, figs. 173–174. 1934. (News: *Symbos convexifrons.*)

BARBOUR, E. H., and C. B. SCHULTZ. A new giant camel, Titanotylopus nebraskensis, gen. et sp. nov. Nebraska State Mus., vol. 1, bull. 36, pp. 291–294, figs. 171–172. May, 1934. (New: *Titanotylopus, T. nebraskensis.*)

BARRETT, CHARLES. Stray notes on monotremes. Victorian Nat., vol. 51, no. 1, pp. 22–24, pl. 5. May, 1934.

BASTIN, A. Études morphologiques sur les Eléphants fossiles du Département des Ardennes. Ostéologie et Dentition. Ann. Soc. Géol. Nord, vol. 57, pp. 87–101, figs. 5. 1932.

BEHNING, ARVID. Eine zahme Igelart. Natur und Volk, vol. 64, no. 4, p. 139, illus. April, 1934. (*Hemeichinus auritus.*)

BÉLA, BODNAR. Le spalax de Hongrie. (Spalax hungaricus Nehring.) La Terre et la Vie, vol. 4, no. 6, pp. 323–333, illus. June, 1934.

Beliajeva, E. Catalogue of the Geological Museum. Vertebrata. Mammalia. Rhinoceratidae. Genus *Epiaceratherium* Abel. Trudy Geologischeskogo Muzeia Akademii Nauk SSSR (Trav. Mus. Géol. Acad. Sci. URSS), vol. 6, pp. 179–193. 1930.

——— Einige Data über fossile Elephanten der Halbinsel Taman. Bull. Acad. Sci. URSS, ser. 7, Cl. Sci. Math. et Nat., Leningrad, no. 8, pp. 1209–1211. 1933. (In Russian, with short German summary.)

——— Neue Data über quartäre Säugetiere von West-Sibirien. Bull. Acad. Sci. URSS, ser. 7, Cl. Sci. Math. et Nat., Leningrad, no. 8, pp. 1205–1207. 1933. (In Russian, with short Germany summary.)

Beljaev, A. M. Les rongeurs du Kazakstan (Mammalia, Rodentia.). Trav. Inst. Zool. Acad. Sci. de l'URSS, Leningrad, vol. 2, no. 1, pp. 37–40. 1934.

Belopolski, L. O. Die wildlebenden Paarhufer (Artiodactyla, Mammalia) des Anadyr-Tschukotka-Gebietes (vorläufige Mitt.). Trav. Inst. Zool. Acad. Sci. de l'URSS, Leningrad, vol. 1, pp. 181–186, map. (1932) 1933. (In Russian, with German summary.)

Berckhemer, F. Der Steinheimer Urmensch und die Tierwelt seines Lebensgebietes. Aus der Heimat, Naturw. Monatsschr., Stuttgart, Jahrg. 47, no. 4, pp. 101–115, figs. 9, pls. 21–24. April, 1934.

Bilkevič, Sr. J. Le chat déserticole (*Erimailurus thinobius* Ognev, Mammalia). Trav. Inst. Zool. Acad. Sci. de l'URSS, Leningrad, vol. 2, no. 1, (1933), pp. 1–3. 1934.

Boas, J. E. V. Der Hinterfuss von *Caenolestes*. Det Kgl. Danske Videnskabernes Selskab. Biol. Meddel., vol. 10, no. 6, pp. 8, pl. 1. 1933.

——— Über die verwandtschaftliche Stellung der Gattung Antilocapra und der Giraffiden zu den Übrigen Wiederkäuern. Det Kgl. Danske Videnskabernes Selskab. Biol. Meddel., vol. 11, no. 3, pp. 15, pl. 1. 1934.

Bobrinskoy, N. Geographical distribution of the deer in Middle Asia (western Turkestan.). Zoologitscheskij Journal (vormals "Revue Zool. Russe"), Moskau, vol. 12, pt. 4, pp. 77–86. 1933. (In Russian, with English summary.)

Bode, Francis D. Tooth characters of protohippine horses with special reference to species from the Merychippus zone, California. Carnegie Inst. Washington, Publ. 453, pp. 39–63, figs. 6, pls. 2. December 20, 1934. (New: *Merychippus brevidontus*.)

Bordas, Alejandro F. Notas sobre los Eutatinae. Nueva subfamilia extinguida de Dasypodidae. Anal. Mus. Argentino Cienc. Nat. "Bernardino Rivadavia," Buenos Aires, vol. 37, pp. 583–614, figs. 15, pls. 57–61. November 30, 1933. (New: *Eutatinae*, *Eutatus ameghinoi*, *Doellotatus chapadmalensis*, *D. simpsoni*.)

Bourdelle, E. Les équidés préhistoriques représentés par les dessins et sculptures rupestres des grottes des Eyzies (Dordogne). Bull. Soc. Nat. Acclimat. France, vol. 80, no. 12, pp. 461–465. 1933.

Brazenor, C. W. First record of a beaked whale (*Mesoplodon greyi*) from Victoria. Proc. Roy. Soc. Victoria, vol. 45, pt. 1, pp. 23–24, pl. 1. February 28, 1933.

Breuer, Richard, Über das Vorkommen sogenannter keilförmiger Defekte an den Zähnen von *Ursus spelaeus* und deren Bedeutung für die Paläobiologie. Palaeobiologica, vol. 5, pp. 103–113, pls. 6–10. 1933.

Broili, F. Max Schlosser. Centralbl. f. Mineral., Geol. u. Paläont., Stuttgart, Abt. B, no. 1, pp. 69–78. 1933. (Biographical sketch and bibliography.)

Broom, Robert. Evolution—is there intelligence behind it? South African Journ. Sci., vol. 30, pp. 1–19. October, 1933.

Bucher, Kathleen Hill. Nena. Nature Mag., vol. 23, no. 6, pp. 278–280, illus. June, 1934. (Captive jutia, *Capromys pilorides*.)

BURKE, J. J. Mytonolagus, a new leporine genus from the Uinta Eocene series in Utah. Ann. Carnegie Mus., vol. 23, pp. 399–420, 1 pl. November 19, 1934. (New: *Mytonolagus, M. petersoni.*)

——— New Duchesne River rodents and a preliminary survey of the Adjidaumidae. Ann. Carnegie Mus., vol. 23, pp. 391–398, 5 figs. November 19, 1934. (New: *Leptotomus kayi, Adjidaumo douglassi, Protadjidaumo, P. typus, Paradjidaumo* for *Eumys minor* Douglass.)

BURT, WILLIAM HENRY. The mammals of southern Nevada. Trans. San Diego Soc. Nat. Hist., vol. 7, no. 36, pp. 375–427, map, May 31, 1934.

BURTCH, LEWIS A. The Kern County elk refuge. California Fish and Game, vol. 20, no. 2, pp. 140–147. April, 1934.

BURTON, R. W. Bison (*Bibos gaurus* H. Smith) and hybrids in the Mysore Zoo. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 1, pp. 215–216, illus. April 15, 1934.

CABRERA, ANGEL. Los yaguares vivientes y extinguidos de la América austral. Notas prelim. Mus. de La Plata, Buenos Aires, vol. 2, pp. 9–39, pls. 1–11. 1934. (New: *Panthera onca mesembrina.*)

——— Anomalías patológicas dentarias en algunos ungulados pampeanos. Notas prelim. Mus. de La Plata, Buenos Aires, vol. 2, pp. 183–185, pls. 1–2. 1934.

CARILL-WORSLEY, P. E. T. A fur farm in Norfolk. Trans. Norfolk and Norwich Nat. Soc., vol. 13, no. 2, pp. 105–115, pls. 3. (1930–31) 1932.

CARPENTER, C. R. A field study of the behavior and social relations of howling monkeys. Comparative Psychology Monographs, Baltimore, vol. 10, no. 2, serial no. 48, pp. 1–168, figs. 3, pls. 16. May, 1934. (*Alouatta palliata* subsp.)

CHAPPELLIER, A. Le rat musqué en France, November, 1933. (Allemagne-Angleterre). Bull. Soc. Nat. Acclimat. France, vol. 81, no. 4, pp. 172–197, 2 maps. April, 1934.

CHARLEMAGNE, M. Die gegenwärtige Verbreitung des Bibers (Castor fiber L.) in der Ukraine. Mém. Acad. Sci. d'Ukraine, Cl. Sci. Nat. et Tech, no. 5, pp. 251–254. 1931.

——— Materialien zur Fauna der Säugetiere des Kyjiwer Gebiets. Inst. Recherches Zool. et Biol. Acad. Sci. d. 'Ukraine, Trav. Mus. Zool. Kyiv, no. 12, pp. 57–73. 1933. (In Russian, with German summary.)

CHARLES, VERA K., and ALINE FENNER KEMPTON. Microsporum of cats causing ringworm in man. Journ. Washington Acad. Sci., vol. 24, no. 5, pp. 222–227. May 15, 1934.

CHAWORTH-MUSTERS, J. L. A note on the nomenclature of two sciurids from eastern Siberia. Ann. & Mag. Nat. Hist., London, ser. 10, vol. 13, no. 77, pp. 555–557. May, 1934. (*Citellus buxtoni* Allen = *Citellus eversmanni leucostictus* Brandt.)

——— A note on the nomenclature of Phodopus sungorus (Pallas) and its geographical races. Ann. & Mag. Nat. Hist., London, ser. 10, vol. 13, no. 78, pp. 590–591. June, 1934.

COLEMAN, EDITH. The echidna under domestication. Victorian Nat., vol. 51, no. 1, pp. 12–21, pl. 4, figs. May, 1934.

COOK, H. J., and MARGARET C. COOK. Faunal lists of the Tertiary vertebrata of Nebraska and adjacent areas. Nebraska Geol. Surv. paper no. 5, pp. 1–58. 1933.

COUCH, LEO K. Freak rabbit with horny growths from Whidby Island, Washington. The Murrelet, vol. 15, no. 2, p. 54. May, 1934.

CRONEMILLER, F. P. Does have antlers. California Fish and Game, vol. 18, no. 1, p. 83. January, 1932.

DECHAMBRE, ED. La nouvelle singerie du Jardin des Plantes. La Terre et la Vie, vol. 4, no. 6, pp. 368–370, illus. June, 1934.

Dehm, Richard. Listriodon im südbayrischen Flinz (Obermiocän). Centralbl. f. Mineral., Jahrg. 1934, Abt. B, no. 12, pp. 513–528, figs. 17. 1934.

Dobell, Clifford. Researches on the intestinal protozoa of monkeys and man. V. The *Endomilax* of macaques. Parasitology, vol. 25, no. 4, pp. 436–467. December, 1933.

Doutt, J. Kenneth. List of types of mammals in the collection of the Carnegie Museum on April 2, 1934. Ann. Carnegie Mus., vol. 22, nos. 3–4, pp. 317–321. April 2, 1934.

Dubois, Eugene. The shape and size of the brain in *Sinanthropus* and in *Pithecanthropus*. Proc. Koninklijke Akad. van Wetenschappen te Amsterdam, vol. 36, no. 4, pp. 415–423, pls. 1–4. 1933.

——— New evidence of the distinct organization of *Pithecanthropus*. Proc. Koninklijke Akad. van Wetenschappen te Amsterdam, vol. 37, no. 3, pp. 139–145. March, 1934.

Duff, John F. Wild pig hunting in the Kuling foothills. China Journ., vol. 20, no. 4, pp. 204–205, illus. April, 1934.

Dukel'skaia, N. M. New data on the chemical methods of rat control. La Défence des Plantes, vol. 5, nos. 5–6, pp. 579–585. 1928. (In Russian.)

Eadie, Robert. The platypus in captivity. Victorian Nat., vol. 51, no. 1, pp. 3–11, pls. 1–3. May, 1934.

Edinger, Tilly. Über jungdiluviale Säugetiere aus dem Emschergebiet. Palaeont. Zeitschr., vol. 13, nos. 1–2, pp. 119–133, figs. 9. May 31, 1931.

Eipper, Paul. Berechnende Überlegung beim Schimpansen. Natur und Volk, vol. 64, no. 4, pp. 127–129. April, 1934.

Ehrenberg, Kurt. Bemerkungen zu Karl Rode: Über den ersten Unterkiefermolaren der Bären. Centralbl. Mineral. Geol. u. Paläont., Abt. B., vol. 6, pp. 230–237. 1930.

——— Die paläobiologischen Sammlungen des Paläontologischen und Paläobiologischen Institutes der Universität Wien. Zweite Mitteilung: Darstellung der Fossilisationserscheinungen 1. Palaeobiologica, vol. 4, pp. 356–396, fig. 1. 1931.

——— Die bisherigen Ergebnisse der Grabungen in der Bärenhöhle bei Winden im Burgenland. Palaeont. Zeitschr., vol. 14, nos. 1–2, pp. 37–45. May 31, 1932.

Eller, Hedwig. Der Sinus maxillaris und seine Nachbarorgane bei verschiedenen Affen und beim Hunde. Zeitschr. für Anat. und Entwickl., Berlin, vol. 97, pt. 6, pp. 725–756, figs. 27. June 7, 1932.

English, W. L. Notes on the breeding of a douroucouli (*Aotus trivirgatus*) in captivity. Proc. Zool. Soc. London for 1934, pt. 1, pp. 143–144, pl. 1. April, 1934.

Errington, Paul L. Bobwhite winter survival in an area heavily populated with grey foxes. Iowa State Coll. Journ. Sci., vol. 8, no. 1, pp. 127–130. October, 1933.

Estill, H. W. Deer meat investigation. California Fish and Game, vol. 18, no. 3, pp. 249–250. July, 1932.

Ferrar, M. L. Daily flighting of flying foxes (*Pteropus giganteus* Brunn.). Journ. Bombay Nat. Hist. Soc., vol. 37, no. 1, pp. 214–215. April 15, 1934.

Finley, William L. Are wildcats wild? Nature Mag., vol. 23, no. 4, pp. 189–191, illus. April, 1934.

Field, Harriett Anderson. The limits of learning ability in Rhesus monkeys. Genetic Psychol. Monogr., vol. 15, nos. 5–6, pp. 369–537, figs. 3. May and June, 1934. (With French and German summaries.)

Flerov, C. C. On the geographical distribution and systematics of elks or moose (*Alces* Gray). Comptes Rendus Acad. Sci. URSS, vol. 2, no. 2, pp. 137–143. April 11, 1934.

FORMOSOV, A. N. Über Karten geographischer Verbreitung von Jagdtieren. Zoologitscheskij Journal (vormals "Revue Zool. Russe"), Moskau, vol. 12, pt. 4, pp. 110–116. 1933. (In Russian, with German summary.)

FOSTER, MARK A. The reproductive cycle in the female ground squirrel, Citellus tridecemlineatus (Mitchill). Amer. Journ. Anat., vol. 54, no. 3, pp. 487–506, pls. 1–2. May 15, 1934.

FRASER, F. C. The blue whale skeleton in the whale hall. Nat. Hist. Mag. (Brit. Mus.), vol. 4, no. 30, pp. 228–230. April, 1934.

FRECHKOP, SERGE. Notes sur les mammifères. XVI. Les mammifères rapportés, en 1932, de l'Extrême-Orient par S.A.R. le Prince Léopold de Belgique. Bull. Mus. roy. d'Hist. Nat. Belgique, Bruxelles, vol. 10, no. 14, pp. 1–37, figs. 3, pl. 1. April, 1934.

FRIANT, MADELEINE. Sur les affinités de l'Issiodoromys, Rongeur de l'Oligocène d'Europe. Comptes Rendus Acad. Sci. Paris, vol. 197, no. 19, pp. 1059–1061, fig. 1. 1933. (*Issiodoromys*, an advanced theridomyid.)

FURLONG, EUSTACE L. New merycodonts from the Upper Miocene of Nevada. Carnegie Inst. Washington, Publ. 453, pp. 1–10, 5 pls. May 25, 1934. (New species: *Merycodus lozocerus*, *M. hookwayi*.)

GILLAN, G. V. B. The distribution of the great Pamir sheep (*Ovis ammon poli* Blyth). Journ. Bombay Nat. Hist. Soc., vol. 37, no. 1, pp. 216–217. April 15, 1934.

GOODWIN, GEORGE G. The gray squirrel migration. Nature Mag., vol. 23, no. 5, pp. 221–222, 255–256, illus. May, 1934.

——— Conservation. Bialowies the old and new home of the European bison. The wood bison, plains bison, and proghorn antelope in America. Natural History, New York, vol. 34, no. 3, pp. 298–301, illus. May–June, 1934.

——— Two new mammals from Kazakstan. Amer. Mus. Novitates no. 742, pp. 2. August 27, 1934. (New: *Crocidura suaveolens mordeni*, *Microtus gravesi*.)

GRAHAM, RITSON. Ancient red deer antler on a Solway marsh. North Western Naturalist, vol. 9, no. 2, p. 151, pl. 1. June, 1934.

GREGORY, WILLIAM KING. A half century of trituberculy, the Cope-Osborn theory of dental evolution. Proc. Amer. Philos. Soc., vol. 73, no. 4, pp. 169–317, figs. 71. April, 1934.

GRIGOR, G. G. Discovery of fossil bears near Krasnodar, Caucasus. Trudy Geologicheskogo Muzeia Akademii Nauk SSSR (Trav. Mus. Géol. Acad. Sci. URSS), vol. 6, pp. 31–36, 1 fig. 1930. (In Russian.)

GROMIER, (DR.) En brousse Africaine. Souvenirs et observations zoologiques. La Terre et la Vie, vol. 4, no. 6, pp. 355–365, illus. June, 1934.

GROMOWA, VERA. Die Säugetierfauna der mittelpaläolithischen Station bei Ilskaja im nördlichen Kaukasus. Trav. Inst. Zool. Acad. Sci. de l'URSS, Leningrad, vol. 1, pp. 305–346, pls. 1–4. (1932) 1933. (In German, with Russian summary.)

HAMLETT, G. W. D. Nema parasites in embryo bats. Biol. Bull., vol. 66, no. 3, pp. 357–360. June, 1934.

HAUGHTON, S. H. On some South African fossil Proboscidea. Trans. Roy. Soc. South Africa, vol. 21, no. 1, pp. 1–18, 4 pls., 8 figs. December, 1932. (New: *Pilgrimia archidiskodontoides*, *P. subantiqua*.)

HECK, LUTZ. Vom Elch: Fang, Hege und Wiedereinbürgerung durch den Berliner Zoologischen Garten. Zool. Garten, n. F., vol. 7, nos. 1–3, pp. 1–16, 17 figs. May, 1934.

——— Elche in Deutschland. Naturforscher, vol. 11, no. 2, pp. 37–42, pl. 4, figs. 1–6. May, 1934.

HEDIGER, H. Über einen Fall von Zahmheit bei Didelphys. Zool. Garten, n. F., vol. 7, nos. 1–3, pp. 28–44, 9 figs. May, 1934.

HELLER, FLORIAN. Jüngstpliocäne Knochenfunde in der Moggaster-Höhle. (Fränkische Schweiz.). Centralbl. Mineral. Geol. u. Paläont., Abt. B., 1930, no. 4, pp. 154–159, figs. 4. 1930. (New: *Mimomys franconicus.*)

——— Ein Nachtrag zur Forest-Bed-Fauna aus der Sackdillinger Höhle (Oberpfalz). Centralbl. f. Mineral., Geol. u. Paläont., Stuttgart, Abt. B., no. 1, pp. 60–68, figs. 4. 1933. (New: *Glis sackdillingensis, Martes intermedia.*)

——— Ein Schädelfund von *Lophiodon munieri* Filh. in der eozänen Braunkohle des Geiseltales bei Halle (Saale). Palaeont. Zeitschr., vol. 15, no. 1, pp. 46–57. March 31, 1933.

HERKLOTS, G. A. C. Civet cats of Hong Kong. Hong Kong Nat., vol. 5, no. 2, pp. 91–94, pl. 7. June, 1934.

HIBBARD, CLAUDE W. A new Bassariscus from the Lower Pliocene of Nebraska. Univ. Kansas Sci. Bull., vol. 21, no. 7, pp. 273–278, pl. 26, figs. 1–3. March 15, 1933. (New: *Bassariscus ogallalae.*)

——— Two new genera of Felidae from the Middle Pliocene of Kansas. Trans. Kansas Acad. Sci., vol. 37, pp. 239–255, pls. 4–6. 1934. (New: *Pratifelis, P. martini, Adelphailurus, A. kansensis.*)

HILL, J. P. The developmental history of the Primates. (Croonian lecture.) Philos. Trans. Roy. Soc. London, ser. B, vol. 221, B 475, pp. 45–178, figs. 17, pls. 21. 1932.

HINTON, MARTIN A. C. The black rat as a national menace. A roof climber that may bring back the plague. Field, London, vol. 162, no. 4223, p. 1421, illus. December 2, 1933.

HJORT, JOHAN, J. LIE, and JOHAN T. RUDD. Pelagic whaling in the Antarctic. IV. The season 1933–1934, with a note on: Limits of the pack ice in the Antarctic in the area between 40° W. and 110° E., by H. E. Hanson. Hvålradets Skrifter, Sci. Results Marine Biol. Res., Oslo, no. 9, pp. 1–59, figs. 10, pls. 7. 1934.

HOWE, HOWARD A. The basal diencephalon of the armadillo. Journ. Comp. Neurol., vol. 58, no. 2, pp. 311–357, pls. 1–9. October, 1933.

HUESTIS, R. R., and ELIZABETH BARTO. Brown and silver deer mice. Journ. Heredity, vol. 25, no. 6, pp. 219–223, figs. 3–4. June, 1934.

HUEY, LAURENCE M. A new form of pocket gopher from southern Mono County, California. Trans. San Diego Soc. Nat. Hist., vol. 7, no. 35, pp. 373–374. May 31, 1934. (New: *Thomomys quadratus monoensis.*)

HUGUES, ALBERT. Le castor du Rhône. Bull. Soc. Nat. Acclimat. France, vol. 80, no. 9, pp. 341–350; no. 10, pp. 381–395, 1 fig.; no. 11, pp. 425–439. Sept.–Oct.–Nov., 1933.

HUTCHINSON, W. I. Destruction of wild life in the Matilja fire. California Fish and Game, vol. 19, no. 2, pp. 126–128, figs. 45–46. April, 1933.

ICHES, LUCIEN. Le Jabali facétieux (*Dicotyles tayacu*, Gray). Bull. Soc. Nat. Acclimat. France, vol. 81, no. 4, pp. 166–171. April, 1934.

IREDALE, TOM, and E. LE G. TROUGHTON. A check-list of the mammals recorded from Australia. Australian Mus., Sydney, mem. 6, pp. xi + 122. May 4, 1934.

IRVING, LAURENCE. On the ability of warm-blooded animals to survive without breathing. Scientific Monthly, vol. 38, pp. 422–428. May, 1934.

JACOBSHAGEN, E. Studien am Oberkiefergebiss des wollharigen Nashorns *Rhinoceros lenensis* Pallas (*antiquitatis* Blumenb.). Palaeont. Zeitschr., vol. 15, no. 4, pp. 246–279, figs. 25. December 31, 1933.

JEPSEN, GLENN L. A revision of the American Apatemyidae and the description of a new genus, *Sinclairella*, from the White River Oligocene of South Dakota. Proc. Amer. Philos. Soc., vol. 74, no. 4, pp. 287–305, figs. 4, pls. 1–3. August, 1934. (New: *Sinclairella, S. dakotensis.*)

JURGENSON, P. Über die variabilität des Hermelinschädels (*Mustela erminea* L.). Zoologitscheskij Journal (vormals "Revue Zool. Russe"), Moskau, vol. 12, pt. 1, pp. 60–68. 1933. (In Russian, with German summary.)

KALABOUKHOV, N. S. The duration of life of *Citellus pygmaeus* Pall. (Rodentia) studied by means of the banding method. Wissensch. Berichte der Moskauer Staats-Universität, pt. 1, pp. 29–34. 1933. (In Russian, with English summary.)

KAPPERS, C. U. ARIENS. The forebrain arteries in Plagiostomes, reptiles, birds, and Monotremes. Proc. Koninklijke Akad. van Wetenschappen te Amsterdam, vol. 36, no. 1, pp. 52–62. 1933.

KARAVAEV, V. Fossil *Elephas primigenius* at the village Rulikiv, Motovilivka, Ukraine. Acad. Sci. Ukraine, Mém. Cl. Sci. Phys. et Math., Trav. Mus. Zool., no. 8, vol. 15, no. 2, pp. 331–332, figs. 2. 1930. (In Ukrainian, with German summary.)

KELLOGG, W. N. and L. A. KELLOGG. The ape and the child: A study of the environmental influence upon early behavior. 341 pp., 100 figs. Whittlesey House, McGraw-Hill Book Co., New York. 1933. Price $3.00.

KOENIGSWALD, RALPH V. Ein neuer Urmensch aus dem Diluvium Javas. Centralbl. f. Mineral, Geol. u. Paläont., Stuttgart, Abt. B., no. 1, pp. 29–42, figs. 3. 1933. (*Homo* (*Javanthropus*) *soloensis* found at Ngandong, Java.)

KOPPERS, WILH. Der Bärenkult in ethnologischer und prähistorischer Beleuchtung. Palaeobiologica, vol. 5, pp. 47–64. 1933.

KORMOS, THEODOR. Die Eiszeit im Lichte der Biologie. Palaeobiologica, vol. 5, pp. 251–274. 1933.

KOSULIN, M. V. The distribution of *Citellus suslicus suslicus* Gueld. in the province of Riazan. La Défence des Plantes, vol. 5, nos. 3–4, pp. 374–376. 1928. (In Russian.)

KRAGLIEVICH, LUCAS. Un nuevo e interesante roedor de la fauna terciaria de Entre Ríos, "*Caviodon* (*Lelongia*) *paranensis*" n. subgen. n. sp. Anales Soc. Cient. Argentina, vol. 110, no. 3, pp. 178–184, fig. 1. 1930. (New: *Cardiomyinae*, *Lelongia*, *Caviodon* (*Lelongia*) *paranensis*.)

——— Caracteres cráneodentarios del roedor vivente *Monticavia* (*Nanocavia*) *shiptoni* Thom. Anales Soc. Cient. Argentina, vol. 112, no. 6, pp. 337–342, figs. 3. 1931.

——— Sobre la presencia de toxodontes haplodontéridos en el piso araucanense de Catamarca "*Toxodontherium andinum*" n. sp. Anales Soc. Cient. Argentina, vol. 111, no. 2, pp. 93–96, 1 fig. 1931. (New: *Toxodontherium andinum*.)

KROGH, AUGUST. Physiology of the blue whale. Nature, London, vol. 133, no. 3365, pp. 635–637. April 28, 1934.

KUBACSKA, A. Pathologische Untersuchungen an ungarländischen Versteinerungen II. Palaeobiologica, vol. 5, pp. 159–167, pls. 13–14. 1933.

KURODA, NAGAMICHI. Geographical distribution of mammals in the Kurile Chain. Bull. Biogeogr. Soc. Japan, vol. 3, no. 3, pp. 151–167. November, 1933. (In Japanese, with English summary.)

KURODA, RYO. On the counting ability of a monkey (*Macacus cynomolgus*). Journ. Comp. Psychol., vol. 12, no. 2, pp. 171–180. August, 1931.

LAVROV, N. To the biology of the musk-rat (Musquash) Fiber zibethicus L. Zoologitscheskij Journal (vormals "Revue Zool. Russe"), Moskau, vol. 12, pt. 1, pp. 86–100. 1933. (In Russian, with German summary.)

LAWROW, N. Einige Tatsachen über die Ernährung der Bisamaratte (*Fiber zibethicus* L.) Zoologitscheskij Journal (vormals "Revue Zool. Russe"), Moskau, vol. 12, pt. 2, pp. 67–79. 1933. (In Russian, with German summary.)

LOOMIS, F. B. A new Oligocene dog. Amer. Journ. Sci., vol. 22, no. 128, pp. 100–102, 4 figs. August, 1931. (New: *Brachicyon*, *B. intermedius*.)

MAGEE, H. E. Observations on digestion in the ruminant. Journ. Exper. Biol., vol. 9, no. 4, pp. 409–426, figs. 9. October, 1932.

MALM, E. N. Die Delphine des Schwarzen Meeres. Priroda, Verlag Akad. Wiss. USSR, no. 2, pp. 31–39, figs. 4. 1933. (In Russian.)

MÁTAYÁS, JENÓ, and MIHÁLY SZABÓ. Das nähere Verwandtschaftsverhältnis zwischen dem Menschen und den Anthropoiden auf Grund mikroosteologischer Untersuchungen auch mit Rücksicht auf die feinere Knochenstruktur der Carnivoren und Ungulaten. Zeitschr. für Anat. und Entwick., Berlin, vol. 97, pts. 1–2, pp. 169–209, figs. 5, pls. 17. March 15, 1932.

MEDVEDEV, A. A. New data on birds and mammals of the Penza government (Central Russia). Bull. Soc. Nat. Moscou, Sect. Biol., vol. 41, nos. 1–2, pp. 121–124. 1932. (In Russian.)

MEYER, K. F. Diseases of wild life transmissible to man. California Fish and Game, vol. 18, no. 3, pp. 203–207. July, 1932.

MURRAY, J. M., and C. V. GREEN. Inheritance of ventral spotting in mice. Genetics, vol. 18, no. 6, pp. 481–486. 1933.

NISHIOKA, KANICHI. Some histological observations on the submandibular gland of the rabbit. Annotationes Zool. Japonenses, Tokyo, vol. 13, no. 4, pp. 337–343, pls. 19–21. May 5, 1932.

OGNEV, S. Materialien zur Systematik, Morphologie und Geographischen Verbreitung der Soriciden. Zoologitscheskij Journal (Vormals "Revue Zool. Russe"), Moskau, vol. 12, pt. 4, pp. 8–16. 1933. (In Russian, with German summary.)

OLDHAM, CHAS. Risso's dolphin off the coast of Caernarvonshire. North Western Naturalist, vol. 9, no. 1, pp. 50–51. March, 1934. (Records *Grampus griseus* Cuv.)

ORR, ROBERT T. Descriptions of three new races of brush rabbit from California. Proc. Biol. Soc. Washington, vol. 48, pp. 27–30. February 6, 1935. (New: *Sylvilagus bachmani tehamae, S. b. macrorhinus, S. b. riparius.*)

PATTERSON, A. H. The disappearing harvest mouse. Field, London, vol. 162, no. 4216, p. 979. October 14, 1933.

PEACOCK, E. H. Where big game "take the waters." A hidden watcher at a Burmese "salt-lick." Field, London, vol. 162, no. 4216, pp. 970–971, illus. October 14, 1933.

PEI, WEN-CHUNG. On the Carnivora from locality 1 of Choukoutien. Palaeontologia Sinica, Peiping, ser. C, vol. 8, fasc. 1, pp. 216, figs. 47, pls. 24. May, 1934. (New: *Canis lupus variabilis, Canis cyonoides, Lutra melina, Hyaena zdanskyi, Hyaena licenti, Felis youngi, Felis teilhardi.*)

——— Report on the excavation of the locality 13 in Choukoutien. Bull. Geol. Soc. China, vol. 13, no. 3, pp. 359–367, figs. 4. 1934. (List of species of mammals.)

——— A preliminary report on the late Palaeolithic cave of Choukoutien. Bull. Geol. Soc. China, vol. 13, no. 3, pp. 327–358, figs. 10, pls. 4. 1934. (Lists mammals found in the cave.)

PETERSON, O. A. List of species and description of new material from the Duchesne River Oligocene, Uinta Basin, Utah. Ann. Carnegie Mus., vol. 23, pp. 373–389, 8 figs. November 19, 1934. (New: *Leptomeryx minutus, Epitriplopus medius, Hyracodon primus, Protictops, P. alticuspidens, Mesagriochoerus, M. primus.*)

PINCUS, G., and E. V. ENZMANN. Fertilization in the rabbit. Journ. Exper. Biol., vol. 9, no. 4, pp. 403–408, figs. 5. October, 1932.

PITT, FRANCES. The mysterious badger. Field, London, vol. 162, no. 4205, p. 291, illus. July 29, 1933.

——— Wild life prepares for winter. Field, London, vol. 162, no. 4218, p. 1095, illus. October 28, 1933.

PITTIER, R., Y [G.] H. H. TATE. Sobre fauna Venezolana. Lista provisional de los mámiferos observada en el País. Bol. Soc. Venezolana Cienc. Nat., Caracas, no. 7, pp. 249–278. 1932.

POCOCK, R. I. The palm civets or 'toddy cats' of the genera *Paradoxurus* and *Paguma* inhabiting British India. Pt. 3. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 2, pp. 314–346, figs. 5–7. August 15, 1934. (New: *Paguma larvata neglecta.*)

——— The geographical races of *Paradoxurus* and *Paguma* found to the east of the Bay of Bengal. Proc. Zool. Soc. London for 1934, pt. 3, pp. 613–683, figs. 11, pls. 1–2. September 14, 1934. (New: *Paradoxurus hermaphroditus cantor.*)

——— Preliminary diagnoses of some new races of South Arabian mammals. Ann. & Mag. Nat. Hist., London, ser. 10, vol. 14, no. 84, pp. 635–636. December, 1934. (*Paraechinus dorsalis albior, Arvicanthis niloticus naso, Canis lupus arabs, Vulpes ruppelli sabaea, Hyaena hyaena sultana, Oryx leucoryx laticeps.*)

POOLE, CHARLES G. Some facts about predatory animal control. California Fish and Game, vol. 19, no. 1, pp. 1–9, figs. 1–2. January, 1933.

PORTAL, M. Black mountain hares. Field, London, vol. 162, no. 4218, p. 1101. October 28, 1933. (Two killed at Sciberscross, Sutherland.)

RIETH, A. Der Lebensraum grabender Tiere in seiner Beziehung zu den Köppen'schen Klimaprovinzen. (Ein tiergeographischer Versuch.) Palaeobiologica, vol. 5, pp. 211–241, maps 3. 1933.

REVERDIN, L. Sur la faune du kjokkenmodding morbihannais, Er Yoh, et ses rapports avec celle des stations néolithiques lacustres de la Suisse. Archiv. Suisses Anthropol. Gén., vol. 6, nos. 1–2, pp. 79–86. 1932–33. (Lists mammals found in kitchen-midden on Er Yok Island, Brittany.)

RODE, KARL. Über die Bären von Taubach und Ehringsdorf. Palaeont. Zeitschr., vol. 13, nos. 1–2, pp. 61–72, figs. 2. May 31, 1931.

RUSCONI, CARLOS. La presencia del género "Lontra" en la fauna Ensenadense de Buenos Aires. Anales Soc. Cient. Argentina, vol. 114, no. 3, pp. 149–151, figs. 1. 1932. (New: *Lontra paranense lozanoi.*)

——— Observaciones geológicas y nuevos restos de mamíferos fósiles del Uruguay. Anal. Mus. Hist. Nat. Montevideo, ser. 2, vol. 4, no. 6, pp. 1–12. August, 1934. (New: *Lagostomopsis aznarezi.*)

RUSSELL, L. S. Revision of the Lower Oligocene Vertebrate Fauna of the Cypress Hills, Saskatchewan. Trans. Royal Canadian Inst., vol. 20, pt. 1, pp. 49–67, pls. 7–10. 1934. (New: *Daphoenus canadensis, D. lambei, Hyracodon browni, Brontops canadensis, Menodus cutleri, M. lambei, Orienotherium* for *Chalicotherium bilobatum* Cope.)

——— A Middle Eocene mammal from British Columbia. Amer. Journ. Sci., ser. 5, vol. 29, no. 169, pp. 54–55. January, 1935. (Family Tillotheriidae represented by *Trogosus minor.*)

SCHLAIKJER, ERICH M. 1935. Contributions to the stratigraphy and palaeontology of the Goshen Hole area, Wyoming. III. A new basal Oligocene formation. Bull. Mus. Compar. Zool. at Harvard College, vol. 76, no. 3, pp. 71–93, figs. 10, pls. 8. January, 1935. (New: *Miacis matthewi, Hemipsalodon cooki, Ateleodon osborni, Hyracodon ischyrolophus, Caenopus yoderensis, Subhyracodon woodi, Leptomeryx yoderi.*)

SCHMIDTGEN, O. Die Drachenhöhle bei Mixnitz. Palaeobiologica, vol. 4, pp. 305–320. 1931.

SCHREUDER, A. *Conodontes, Trogontherium* and the other Castoridae. Palaeont. Zeitschr., vol. 13, nos. 1–2, pp. 148–176, figs. 6. May 3, 1931.

SCHUMACHER, SIEGMUND. Muskeln und Nerven der Fledermausflughaut. Nach Untersuchungen an Pteropus. Zeitschr. für Anat. und Entwickl., Berlin, vol. 97, pt. 5, pp. 610–621, figs. 2. May 13, 1932.

SETH-SMITH, D. When winter comes to Whipsnade. Animals which like the snow. Field, London, vol. 162, no. 4222, pp. 1364–1365, illus. November 25, 1933.

SEWERTZOFF, S. A. Zum Problem der Dynamik der Herde bei den Wirbelthieren. Bull. Acad. Sci. URSS. ser. 7, Cl. sci. math. et nat., Leningrad, no. 7, pp. 1005–1046, 1933. (In Russian with German summary.)

SICKENBERG, OTTO. Ein Schädelstück von *Manatherium delheidi* Hartl. Palaeont. Zeitschr., vol. 11, no. 2, pp. 86–101, figs. 1–3, pls. 3–4. July 22, 1929.

——— *Parurmiatherium rugosifrons*, ein neuer Bovide aus dem Unterpliozän von Samos. Palaeobiologica, vol. 5, pp. 81–102, figs. 6, pls. 4–5. 1933.

SIMIONESCU, I. Tertiäre und pleistozäne Camelidae in Rumanien. Bull. Sec. Sci. de l'Acad. Roumaine, vol. 15, nos. 1–2, pp. 1–8, figs. 1–6. 1932.

SIMPSON, GEORGE GAYLORD. Provisional classification of extinct South American hoofed mammals. Amer. Mus. Novitates no. 750, pp. 21. October 9, 1934. (New: *Notioprogonia*, *Trigonostylopoidea*.)

SIVERS, WOLFANG VON. Die Struktur der Hand-und Fusswurzel des Höhlenbären von Mixnitz. Palaeobiologica, vol. 4, pp. 257–304, figs. 15, pls. 25–30. 1931.

SKORKOWSKI, EDWARD. Badanie pochodzenia koni europejakich. Roczniki Nauk Rolnícezh i Lésnych, vol. 29, no. 1, pp. 1–15. 1933. (Investigation of the origin of European horses.)

SMILEY, D. C. A fawn's hiding place. Yosemite Nature Notes, vol. 13, no. 11, pp. 82–83. November, 1934.

SPASSKI, P. Fundorte der fossilen Wale in der Nähe von der Stadt Derbent. Priroda, Verlag Akad. Wiss. USSR., no. 11, p. 72. 1933. (In Russian.)

ST. LEGER, J. On two "red duikers" from Mt. Elgon and Mt. Kenya, East Africa. Ann. & Mag. Nat. Hist., London, ser. 10, vol. 14, pp. 382–385. September, 1934. (New: *Cephalophus fosteri*, *Cephalophus hooki*.)

STOCK, CHESTER. Eocene land mammals on the Pacific Coast. Proc. Nat. Acad. Sci., vol. 18, no. 7, pp. 518–523, figs. 4. July, 1932.

——— An upper Oligocene mammalian fauna from Southern California. Proc. Nat. Acad. Sci., vol. 18, no. 8, pp. 550–554, figs. 2. August, 1932.

——— On the occurrence of an oreodont skeleton in the Sespe of South Mountain, California. Proc. Nat. Acad. Sci., vol. 20, no. 9, pp. 518–523, figs. 2, pls. 2. September, 1934. (New: *Eporeodon thurstoni*.)

——— A new genus of rodent from the Sespe Eocene. Bull. Geol. Soc. America, vol. 46, pp. 61–68, pl. 6. January 31, 1935. (New: *Eohaplomys*, *E. serus*, *E. matutinus*, *E. traduz*.)

——— Plesiomiacis, a new creodont from the Sespe Upper Eocene, California. Proc. Nat. Acad. Sci., vol. 21, no. 2, pp. 119–122, fig. 1. February, 1935. (New: *Plesiomiacis*, *Viverravus* (*Plesiomiacis*) *progressus*.)

ŠULC, K. Zur Anatomie und Histologie der Lippen bei *Microtus arvalis* (Pallas). Biol. Spisy Acad. Veterinariae, Brno, vol. 8, pt. 3, no. B 113, pp. 1–8, figs. 4. 1929. (In Czechoslovakian, with resumé in German.)

——— Über die der Zahl nach reduzierten Tarsaldrüsen bei den Wühlmäusen (Microtinae). Biol. Spisy Acad. Veterinariae, Brno, vol. 8, pt. 4, no. B. 114, pp. 1–14, figs. 10. 1929. (In Czechoslovakian, with resumé in German.)

——— Das Haarkleid von *Microtus arvalis* Pallas. Biol. Spisy Acad. Veterinariae, Brno, vol. 9, pts. 10–11, no. B. 136–137, pp. 1–103, figs. 27. 1930. (In Czechoslovakian, with resumé in German.)

SUMMER, E. L., JR. An outline of the habits of the striped skunk and little spotted skunk with some directions for trapping. California Fish and Game, vol. 18, no. 1, pp. 34–43. January, 1932.

SUSCHKIN, P. P. Die Hochlandgebiete der Erde und die Frage über den Ursprung des Menschen. Palaeobiologica, vol. 5, pp. 275–306. 1933.

T. ——— Seals on the coast of Wales. Field, London, vol. 162, no. 4226, p. 1591. December 23, 1933.

T. ———, K. Night watch in Kenya. Elephant and rhinoceros while you wait. Field, London, vol. 162, no. 4215, p. 921, illus. October 7, 1933.

TELLIER, M. Le macaque saisit-il le rapport logique? Bull. Soc. Roy. Sci. Liége, no. 11, pp. 227–231. 1932.

THOMPSON, ARTHUR R. Nature by day. Ivor Nicholson and Watson, London, pp. xi + 162. 1932.

TOKUDA, MITOSI. Preliminary notes on some small mammals from Sado Island. Annotationes Zool. Japonenses, Tokyo, vol. 14, no. 2, pp. 235–240, pl. 11. October 25, 1933. (New: *Microtus montebelli brevicorpus*.)

TRUE, GORDON H., JR. Repellents and deer damage control. California Fish and Game, vol. 18, no. 2, pp. 156–165. April, 1932.

——— Damage by deer to crops in California. California Fish and Game, vol. 18, no. 2, pp. 136–147, figs. 27–31. April, 1932.

TUROV, S., and D. KRASOVSKY. Über die Fauna des Hirschschutzgebietes am Flusse Sulak. Zoologitscheskij Journal (vormals "Revue Zool. Russe"), Moskau, vol. 12, pt. 4, pp. 35–56. 1933. (Mammals, pp. 39–44.) (In Russian, with German summary.)

USCHATINSKAJA-DEKALENKO, R. S. Zur Ökologie von *Prometheomys*. Priroda, Verlag Akad. Wiss. USSR., no. 11, pp. 71–72. 1933. (In Russian.)

VANDER HOOF, V. L. Additions to the fauna of the Tehama Upper Pliocene of Northern California. Amer. Journ. Sci., vol. 25, pp. 382–384. May, 1933.

VRTIS, V. The cutaneous umbilical glandular organ of the hamster *Cricetus cricetus* (L.). Publ. Biol. l'École des Hautes Études Vétérinaires, Brno, vol. 11, pt. 13, no. B. 163, pp. 1–16, figs. 5. 1932. (In Czechoslovakian, with resumé in English.)

WEIGELT, JOHANNES. Über ein Leichenfeld in der Mittelkohle der Braunkohlen-Grube Cecilie im Geiseltal (Mitteleozän). Palaeobiologica, vol. 4, pp. 49–78, pl. 1. 1931.

WESTENHÖFER, M. Über die primitive Stellung der Menschen unter den Säugetieren. Mitteil. Anthropol. Ges. Wien, vol. 60, nos. 2–3, pp. 171–180. 1930.

WILSON, ROBERT W. Two rodents and a lagomorph from the Sespe of the Las Posas Hills, California. Carnegie Inst. Washington, Publ. 453, pp. 11–17, fig. 1, pl. 1. July 14, 1934. (New: *Sespemys*, *S. thurstoni*.)

——— A new species of Dipoides from the Pliocene of Eastern Oregon. Carnegie Inst. Washington, Publ. 453, pp. 19–28, fig. 1, pl. 1. December 20, 1934. (New: *Dipoides stirtoni*.)

——— Cricetine-like rodents from the Sespe Eocene of California. Proc. Nat. Acad. Sci., vol. 21, no. 1, pp. 26–32, pl. 1. January, 1935. (New: *Eumysops*, *E. simplex*, *E. vetus*.)

WJASHLINSKY, D., and L. SCHAPOSCHNIKOV. Versuch der Unterbringung der Desmane (*Myogale moschata* Pall.) im Gehege der Zentralen Station für Biologie und Jagdwesen (Moskau). Zoologitscheskij Journal (vormals "Revue Zool. Russe"), Moskau, vol. 12, pt. 1, pp. 69–85. 1933. (In Russian, with German Summary.)

WÜST, EWALD. Die Bedeutung der geographischen Rassen für die Geschichte der diluvialen Säugetierfaunen. Paleont. Zeitschr., vol. 12, pp. 6–13. 1930.

YERKES, ROBERT M. Genetic aspects of grooming, a socially important behavior Pattern. Journ. Social Philos., vol. 4, pp. 3–25. 1933.

——— Suggestibility in chimpanzee. Journ. Social Philos., vol. 5, pp. 271–282. 1934.

YOUNG, C. C., and W. C. PEI. On the fissure deposits of Chinghsinghsien with remarks on the Cenozoic geology of the same area. Bull. Geol. Soc. China, vol. 13, no. 1, pp. 63–71, figs. 4. 1933. (List of species of mammals.)

——— On the cenozoic geology between Loyang and Sian. Bull. Geol. Soc. China, vol. 13, no. 1, pp. 73–90, figs. 8, and map. 1933. (Occurrences of fossil mammals.)

YOUNG, CHUNG-CHIEN. On the Insectivora, Chiroptera, Rodentia and Primates other than Sinanthropus from locality 1 at Choukoutien. Palaeontologia Sinica, Peiping, ser. C, vol. 8, fasc. 3, pp. 160, figs. 51, pls. 10. March 31, 1934. (New: *Neomys bohlini*, *Erinaceus olgai*, *Rhinolophus pleistocaenicus*, *?Hesperopternus giganteus*, *Pteromys brachyodus*, *Arctomys complicidens*, *Sinocastor* for *Chalicomys broilii* Teilhard & Young, *Mus* cf. *musculus bieni*, *Pitymys simplicidens*, *Microtus brandtioides*, *Microtus epiratticeps*, *Siphneus wongi*, *Macacus robustus*.)

——— A review of the early Tertiary formations of China. Bull. Geol. Soc. China, vol. 13, no. 3, pp. 469–503, figs. 17, pl. 1. 1934.

ZENKEWITSCH, L. Beiträge zur Zoogeographie des Nördlichen Polarbasins im zusammenhang mit der Frage über dessen Paläogeographische Vergangenheit. Zoologitscheskij Journal (vormals "Revue Zool. Russe"), Moskau, vol. 12, pt. 4, pp. 17–34. 1933. (In Russian, with German summary.)

ZVEREV, M. Mass development in Siberia of Lagurus lagurus and Arvicola amphibius. La Défence des Plantes, vol. 5, no. 1, pp. 104–105. 1928. (In Russian.)

COMMENT AND NEWS

As this issue goes to press, word is received that Dr. William John Sinclair, professor of Geology at Princeton University, died at Princeton, New Jersey, on March 25, 1935, after an illness of about seven weeks. Professor Sinclair was born at San Francisco, California, on May 13, 1877, and was a graduate of the University of California.

The death of Dr. George Edwin Johnson, professor of Zoology at Kansas State Agricultural College, at Manhattan, Kansas, on March 18, 1935, is also announced. Professor Johnson was born at Clear Lake, South Dakota, on May 3, 1889. He graduated from Dakota Wesleyan College in 1913.

MEMBERSHIP

Anyone interested in any phase of mammalogy is eligible for membership in the American Society of Mammalogists, and if elected will receive the Society's official publication, the Journal of Mammalogy, quarterly. Name and address, with remittance of $3.00 for annual dues, may be sent to the Corresponding Secretary, or to any officer of the Society. Membership is dated from the nearest January, although formal election will not take place until the annnal meeting of the Society following the receipt of application.

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